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Designing a Better Carbon Tax: Only with Reinvestment

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DESIGNING A BETTER CARBON TAX: ONLY WITH REINVESTMENT

STEPHEN SEWALK*

ABSTRACT

The objective of a tax on emissions is to curtail total discharges. Ever since Rio and Kyoto, this seems to be an elusive goal. Many papers have been written on the topic, but none actually solve the dilemma of how to proactively reduce emissions. This Article seeks to solve this issue by designing a better carbon tax to reduce U.S. emissions 90% by 2050. The first step needed is to extend and explain the economics of a carbon tax with reinvestment. I examine and graphically show the economics of the tax and subsequent reinvestment of revenues into building clean power plants. I consider a carbon tax applied uniformly to goods and services based on emissions intensity. This simplifies the challenge of applying the tax by creating a tax structure that is applied in a manner similar to a sales tax, but uses the value added tax (“VAT”) structure. A carbon tax is traditionally associated with cost certainty. To make the tax benefit certain, I propose to use the tax revenues to build new power generation, thereby replacing existing facilities, significantly reducing emissions. This also significantly reduces future energy costs, thereby refunding the monies paid by the people and I demonstrate this using economic graphs. However, while realizing that this is the best policy proposed to date, it does not solve emissions from transportation. Therefore, I take the next step and propose that the tax policy needs to include a directive to convert fossil fuel transportation to fuel cell, battery

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and electric vehicles. Doing so results in U.S. emissions declining 90% by 2050.

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INTRODUCTION

This Article's objective is to propose a solution to reduce U.S. emission 90% by 2050. This is done by developing the legal and economic rationale for a carbon tax policy along with a transportation policy replacing CAFÉ standards, and then examining the results and implications of achieving this objective in economic terms specifically for U.S. households. However, to do so it is necessary to understand why this is necessary. Since the 1990s, the world has been implementing carbon policies that have not reduced emissions and therefore not solved the dilemma of climate change.¹ To achieve my goal, I review what has occurred in terms of policy/legislation proposals and their actual or proposed impact.

¹ See Hsiao-Tien Poa & Chung-Ming Tsai, *Multivariate Granger Causality Between CO2 Emissions, Energy Consumption, FDI and GDP: Evidence from a Panel of BRIC Countries*, 36 ENERGY 685, 691–92 (2011).

I then introduce combined carbon tax and transportation legislation/policy and using economic and engineering models, I graph the results of implementing my proposal.

A. *Climate Change and Political (In)Action*

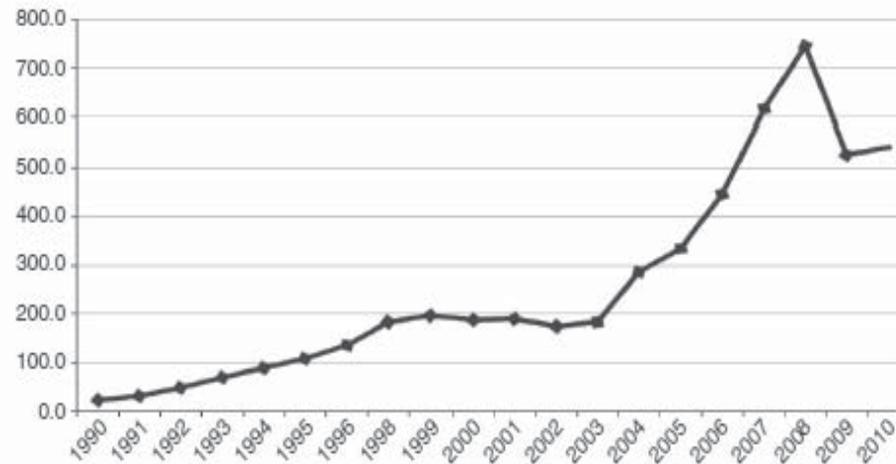
There was great hope with the Earth Summit (1992, Rio de Janeiro, Brazil),² followed by the Kyoto Protocol³ requiring developed countries to curtail greenhouse gas (“GHG”) emissions, that countries would act in a united fashion to tackle climate change.⁴ Rio, followed by Kyoto,⁵ set out a goal to unite the world and reduce emissions, yet the law of unintended consequences created a boom in foreign direct investment (“FDI”) into developing countries as seen in Figure 1.

² Rio de Janeiro hosted the United Nations Conference on Environment and Development (UNCED) from June 3 to June 14, 1992. The conference concluded with the Earth Summit, where leaders from 105 countries gathered to demonstrate their commit to sustainable development. At UNCED over 130 nations signed a Convention of Climate Change. The delegates reached agreement on Agenda 21, an action plan to promote sustainable development in the 21st century. The concept was simplified to developed nations paying developing nations to protect the environment and the developed world should take the lead in reducing global emissions to 1990 levels by the year 2000 based on the UN Intergovernmental Panel on Climate Change prediction regarding global warming. *See generally* STEPHANIE MEAKIN, THE RIO EARTH SUMMIT: SUMMARY OF THE UNITED NATIONS CONFERENCE ON ENVIRONMENT AND DEVELOPMENT (1992), available at <http://publications.gc.ca/Collection-R/LoPBdP/BP/bp317-e.htm> [<https://perma.cc/HHD9-W4BM>] (summarizing the events and results of the Rio Earth Summit).

³ Following the Earth Summit where countries joined the United Nations Framework Convention on Climate Change (“UNFCCC”), the increasingly perceived need for action led to these countries launching negotiations to strengthen the global response to climate change resulting in the Kyoto Protocol being adopted in 1997. *See generally Background on the UNFCCC: The International Response to Climate Change*, U.N. FRAMEWORK CONVENTION ON CLIMATE CHANGE, http://unfccc.int/essential_background/items/6031.php [<https://perma.cc/PS5C-Z6NG>] [hereinafter UNFCCC Background] (describing the background and timeline of the international response to climate change) (last visited Jan. 27, 2016).

⁴ *Id.*

⁵ The goal of the Kyoto Protocol was to reduce greenhouse gas emissions by 5.2% compared to the year 1990 by the year 2010. Press Release, U.N. Framework Convention on Climate Change, Industrialized countries to cut greenhouse gas emissions by 5.2%, (Dec. 11, 1997), <http://unfccc.int/cop3/fccc/info/indust.htm> [<https://perma.cc/9GJS-26QW>]. The agreement did not include developing countries. Nor did anyone anticipate that investment into developing countries and resulting emission levels would boom as a result of companies diversifying their industrial base away from developed countries with potential emissions caps to developing countries with no caps.

Figure 1. FDI inflows to emerging economies, 1990–2010 (billions of \$)

Source: GMID (2012)⁶

Developing countries were not included in Kyoto, as a result these countries were not assigned emissions objectives or restrictions.⁷ It seems Kyoto led to rapidly rising exports as well as emissions from these countries.⁸ When developed countries announced they could cap emissions, multinational companies anticipated higher costs and moved operations by shifting FDI into developing countries—as it allowed countries to benefit because they failed to enact legislation internalizing environmental costs—which resulted in a more polluted world.⁹

The largest amounts of FDI investment were directed to the BRICs.¹⁰ This FDI investment fueled exports while increasing domestic growth (expanding global demand for oil, coal and natural gas).¹¹ By

⁶ Hassan Gholipour Fereidouni, *Foreign Direct Investments in Real Estate Sector and CO₂ Emission: Evidence from Emerging Economies*, 24 MGMT. ENVTL. QUALITY 463, 464 (2013).

⁷ John M. Truby, *Towards Overcoming the Conflict Between Environmental Tax Leakage and Border Tax Adjustment Concessions for Developing Countries*, 12 VT. J. ENVTL. L. 149, 161 (2010).

⁸ See *id.* at 157, 165.

⁹ See *id.* at 157–59.

¹⁰ BRICs, a term coined by Goldman Sachs in the 1990s to represent the largest and quickest growing developing countries, namely Brazil, Russia, India and China.

¹¹ Poa & Tsai, *supra* note 1, at 691–92.

fueling exports, multinational companies magnified global sourcing, thereby further boosting emissions.¹² The reason China blames importers of its goods and services for its emission explosion, assigning one-third of emissions to exports,¹³ was an unintended consequence of Kyoto. However, since 2000, emissions produced within the borders of the United States and the EU have leveled.¹⁴ But if emissions intensities were used, that is GDP divided by total GHG emissions, including those of exports and imports, then total United States and EU emissions have skyrocketed.¹⁵ Meanwhile, forests are continuing to be cut or burned down in Malaysia and Brazil, contributing to global emissions.¹⁶

As FDI continues to expand, emissions have only increased, with the potential that global climate change could change the landscape and characteristics of planet Earth.¹⁷ Over the past fifteen years, twelve are the hottest on record and the largest spike in temperatures in recorded history just happened in February 2016.¹⁸ Further, oceanic temperatures have hit record highs with Arctic ice melting faster than most models had predicted.¹⁹ A 50-year study by NASA found that tropical forests are able to absorb less carbon dioxide as temperatures rise.²⁰ GHG²¹

¹² *Id.*

¹³ Duncan Clark, *West blamed for rapid increase in China's CO₂*, THE GUARDIAN (Feb. 22, 2009), <http://www.theguardian.com/environment/2009/feb/23/china-co2-emissions-climate> [<https://perma.cc/9A22-ZDNW>].

¹⁴ This is primarily due to carbon leakage of industry moving from the United States, EU and Japan to China. It is possible Kyoto had the unintended result of increasing global emissions by moving production from low emission intensity countries to high emission intensity countries.

¹⁵ See generally Clark, *supra* note 13.

¹⁶ A carbon tax policy needs to take this into account, thereby discouraging Brazil and Malaysia from cutting down their forests.

¹⁷ See Stephen Sewalk, *Project Financing an Energy Revolution in the USA*, 3 THE ENG'G PROJECT ORG. J. 141, 141 (2012).

¹⁸ Jason Samenow, *The planet had its biggest temperature spike in modern history in February*, CAPITAL WEATHER GANG (Mar. 14, 2016), <https://www.washingtonpost.com/news/capital-weather-gang/wp/2016/03/14/the-planet-had-its-biggest-temperature-spike-in-modern-history-in-February/> [<https://perma.cc/4FTP-G53B>]; see Barack Obama, President of the United States, *We Need to Act* (June 25, 2013) (transcript available at <http://www.bloomberg.com/news/2013-06-25/-we-need-to-act-transcript-of-obama-s-climate-change-speech.html>). [<https://perma.cc/GCQ4-CJEM>].

¹⁹ *Id.*

²⁰ See Weile Wang, *Variations in Atmospheric CO₂ Growth Rates Coupled With Tropical Temperatures*, 110 PROC. NAT'L ACAD. SCI. 13061 (2013), available at <http://www.pnas.org/content/early/2013/07/17/1219683110> [<https://perma.cc/2LS6-AXUX>].

²¹ See U.N. Framework Convention on Climate Change (UNFCCC), Mar. 21, 1994, 1771 U.N.T.S. 165 (defining "greenhouse gases" as "those gaseous constituents of the atmosphere,

emissions²² attributed to humans represent the majority of the temperature rise over the past fifty years according to analyses conducted by climate scientists. Earth may already be irreparably damaged from changes to the atmospheric composition from excess carbon emissions according to some climate scientists.²³ The bulk of anthropogenic GHGs are from using fossil fuels, per the opinion of the Intergovernmental Panel on Climate Change (“IPCC”).²⁴ Fossil fuels helped our species grow and survive, countries and industries depend on these, yet if we continue to produce and consume them, we put ourselves in danger.²⁵ The general populations’ increasing awareness and knowledge of the effects on climate change from increasing GHGs in the atmosphere is increasing pressure on nations to deal with their carbon emissions.²⁶ A politically acceptable solution to slash levels of emitted GHGs is needed now or Earth’s habitable environment may be transformed irreversibly jeopardizing the future of our own species.

Breakneck unchecked increases in GHG emissions are creating an environment of momentous uncertainty leading to potential of unpredictable and immitigable environment impacts. Climate change on a global scale could lead to melting glaciers, ice, and snowcaps increasing ocean levels, and altering global weather patterns (creating unintended droughts and floods).²⁷ The sea level of the oceans has risen approximately eight

both natural and anthropogenic, that absorb and re-emit infrared radiation”), available at https://treaties.un.org/doc/source/RecentTexts/unfccc_eng.pdf [<https://perma.cc/5KG9-KBNK>] [hereinafter WNFCCC]; see also David G. Duff, *Tax Policy and Global Warming*, 51 CAN. TAX J. 2063, 2065 (2003) (explaining that different gases have different effects on global warming, so emissions are standardized to CO₂ equivalents when measuring effects on global warming).

²² See Camille Parmesan, *Beyond Climate Attribution in Conservation and Ecological Research*, ECOLOGY LETTERS, Special Issue May 2013, at 58, 58, available at <http://online.library.wiley.com/doi/10.1111/ele.12098/epdf> [<https://perma.cc/P92W-B2M9>].

²³ See Robin Kundis Craig, “Stationary is Dead”—Long Live Transformation: Five Principles for Climate Change Adaptation Law, HARV. ENVTL. L. REV., no. 1, 2010, at 9.

²⁴ See INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (IPCC), RENEWABLE ENERGY SOURCES AND CLIMATE CHANGE MITIGATION 3, 7 (Ottmar Edenhofer et al. eds.) (2012), http://srren.ipcc-wg3.de/report/IPCC_SRREN_Full_Report.pdf [<https://perma.cc/79WS-8ABM>] (showing that in 2004 56.6% of CO₂ from fossil fuels was the highest single emission comprising the GHG composition).

²⁵ See Ove Hoegh-Guldberg & John F. Bruno, *The Impact of Climate Change on the World’s Marine Ecosystems*, 328 SCIENCE 1523, 1523 (2010).

²⁶ Stephen Sewalk, *Europe Should Dump Cap-and-Trade in Favor of Carbon Tax with Reinvestment to Reduce Global Emissions*, 5 WASH. & LEE J. ENERGY CLIMATE & ENV’T 355, 358 (2014).

²⁷ Brian C Murray & Heather Housterman, *Climate Change, Cap and Trade, and the Outlook for U.S. Policy*, 34 N.C. J. INT’L L. & COM. REG. 699, 699 (2009).

inches, since 1880, due to global warming.²⁸ According to climate scientists, the oceans could rise anywhere from twenty to eighty additional inches during this century.²⁹ This will displace millions globally, in just the United Kingdom, it could affect almost 500,000 properties,³⁰ and the risk would influence all countries with ocean shorelines.³¹ Approximately 2.6 million homes³² in the United States with five million people are located at four feet or less above full tide.³³ Climate change impacts infrastructure, agriculture, and lifestyle resulting in decreased net worth and standards of living; this is especially true for developing country communities based on agriculture with an economy sensitive to climate variations.³⁴ Many of the world's developing countries are particularly vulnerable to climate change, due to their economies being primarily agriculture-based.³⁵ For all of the meetings since Kyoto, it seemed Copenhagen held the most promise of agreement and progress.³⁶

Concerning Copenhagen, the “ultimate objective of [the Climate] Convention and any related legal instruments . . . is to achieve . . . [the] stabilization of greenhouse gas concentrations in the atmosphere at a

²⁸ Ben Strauss et al., *Surging Seas*, CLIMATE CENTRAL 2 (Mar. 14, 2012), <http://slr.s3.amazonaws.com/SurgingSeas.pdf> [<https://perma.cc/RRD5-Q72S>].

²⁹ *Id.*

³⁰ This would be equivalent of a taking of 500,000 properties in the United Kingdom, because once sea levels rise these properties will be of zero value. See Lizzie Dearden, *House prices map of England and Wales lets you see average cost of homes in your area*, Independent (Feb. 24, 2015), <http://www.independent.co.uk/news/uk/home-news/house-prices-map-of-england-and-wales-lets-you-see-average-cost-of-homes-in-your-area-10067239.html> [<https://perma.cc/3NXC-22G5>] (explaining that with conservatively valuing such properties at \$200,000 the loss would total around \$100 billion loss).

³¹ ENVTL. AGENCY & DEP'T ENV'T FOOD AND RURAL AFFAIRS, NATIONAL FLOOD AND COASTAL EROSION RISK MANAGEMENT STRATEGY FOR ENGLAND 14 (2011), available at https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/228898/9780108510366.pdf [<https://perma.cc/VK8D-WYEE>].

³² Should oceans rise four feet, just forty-eight inches (within the twenty- to eighty-inch range) this would be equivalent to a massive loss of wealth. Assuming homes are only worth \$200,000 on the shore (conservative estimate) would imply a loss of \$520 billion. If they are worth on average \$400,00 or more this century could see losses in the \$1 trillion in property values of just the United States.

³³ Strauss et al., *supra* note 28, at 20.

³⁴ THE WORLD BANK, WORLD DEVELOPMENT REPORT: DEVELOPMENT AND CLIMATE CHANGE 37 (2010) [hereinafter World Development Report].

³⁵ *Id.* at 40.

³⁶ Jutta Brunnée, *From Bali to Copenhagen: Towards a Shared Vision for a Post-2012 Climate Regime?*, 25 MD. J. INT'L. L. 86, 86 (2011), available at <http://digitalcommons.law.umaryland.edu/mjil/vol25/iss1/7> [<https://perma.cc/86WN-BZSU>].

level that would prevent dangerous anthropogenic interference with the climate system.”³⁷ This was the foundation of meetings for Rio, why negotiations and agreement took place for the Kyoto Protocol, setting the foundation for post-2012 commitments.³⁸ With recent scientific analysis, there is now a sense of urgency emerging around the objective.³⁹ Publication of the Fourth Assessment Report by the IPCC in 2007 created a greater seriousness during discussions⁴⁰ and provided unequivocal evidence that humans are creating climate change.⁴¹ In this report, the IPCC indicated that GHG emissions should plateau by 2020 and decline significantly by 2050 to realistically avert dangerous levels of global warming.⁴²

By 2009, it appeared that the largest GHG polluting countries were eager to specify that the world would need to limit warming to two

³⁷ UNFCCC, *supra* note 21, art. 2.

³⁸ States, intergovernmental organizations, and nongovernmental observers routinely invoke the objective in submission to the Ad Hoc Working Group on Long-Term Cooperative Action (“AWG-LCA”). For access to submissions made since the AWG-LCA’s first session in March 2008, see U.N., *Documents of the Ad Hoc Working Group on Long-Term Cooperative Action Under the Convention*, <http://unfccc.int/meetings/adhocworkinggroups/lca/items/4918.php> [<https://perma.cc/B6HS-ZBTG>] (last visited Mar. 20, 2016). See, e.g., U.N. FRAMEWORK CONVENTION ON CLIMATE CHANGE AD HOC WORKING GRP. ON LONG-TERM COOP. ACTION UNDER THE CONVENTION, *Ideas and Proposals on Paragraph 1 of the Bali Action Plan* (2009).

³⁹ See Malte Meinshausen et al., *Greenhouse-Gas Emission Targets for Limiting Global Warming to 2°C*, 458 NATURE 1158, 1158 (2009) (noting that “[m]ore than 100 countries have adopted a global warming limit of 2°C or below (relative to pre-industrial levels) as a guiding principle for mitigation efforts to reduce climate change risks, impacts and damages” (citation omitted)).

⁴⁰ See Richard B. Alley et al., IPCC 2007: *Summary for Policymakers*, in CLIMATE CHANGE 2007: THE PHYSICAL SCIENCE BASIS. CONTRIBUTION OF WORKING GROUP I TO THE FOURTH ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE 1 (Susan Solomon et al. eds., 2007), <https://www.ipcc.ch/pdf/assessment-report/ar4/wg1/ar4-wg1-spm.pdf> [<https://perma.cc/KLC2-D5KH>]. An increasing number of people warns that even the IPCC’s worst-case scenarios are too conservative and that global climate change is occurring at a much faster rate than expected, due to various feedback effects. PEW CTR. ON GLOBAL CLIMATE CHANGE, *Key Scientific Developments Since the IPCC Fourth Assessment Report* (2009), <http://arnmbr.org/content/images/uploads/Pew-Key-Scientific-Developments-Since-IPCC-4th-Assessment.pdf> [<https://perma.cc/H9WC-ATG4>].

⁴¹ See Alley et al., *supra* note 40, at 2–3 (considering it to be “very likely,” i.e., more than ninety percent certain, that anthropogenic factors account for these increases).

⁴² Terry Barker et al., *Technical Summary*, in CLIMATE CHANGE 2007: MITIGATION. CONTRIBUTION OF WORKING GROUP III TO THE FOURTH ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE 25, 38–39, 90 (B. Metz et al. eds., 2007), <https://www.ipcc.ch/pdf/assessment-report/ar4/wg3/ar4-wg3-ts.pdf> [<https://perma.cc/XHW5-7WPC>].

degrees Celsius from levels at the start of the industrial revolution.⁴³ This first occurred at the G8 Summit (2009) in their declarations, the second when President Obama summoned the seventeen countries of the Major Economics Forum (“MEF”) on Energy and Climate, representing eighty percent of global emissions.⁴⁴ The Copenhagen Accord also confirmed the two-degree Celsius benchmark.⁴⁵ This did not satisfy everyone, especially African and small island states, greatly concerned for their future, who pushed heavily for a temperature limit of 1.5 degrees Celsius.⁴⁶ To appease developing countries and assist them in mitigating climate change, developed countries committed to creating an annual fund of \$100 billion under the Copenhagen Accord.⁴⁷ This fund is to be in place by 2020, and the key question is how to raise these funds, which I develop in a future paper.⁴⁸ The fifth assessment report⁴⁹ from the IPCC indicates

⁴³ G8 Leaders Declaration, *Responsible Leadership for a Sustainable Future*, ¶ 65 (2009), http://www.g8italia2009.it/static/G8_Allegato/G8_Declaration_08_07_09_final,0.pdf [<https://perma.cc/AA6H-NX55>].

⁴⁴ *Id.*; Press Release, The White House, Declaration of the Leaders: The Major Economies Forum on Energy and Climate (July 9, 2009), <https://www.whitehouse.gov/the-press-office/declaration-leaders-major-economies-forum-energy-and-climate> [<https://perma.cc/6N92-4MPY>].

⁴⁵ Conference of the Parties to the United Nations Framework Convention on Climate Change, Fifteenth Sess., Copenhagen, Den., Dec. 7–18, 2009, Draft Decision -/CP.15: Proposal by the President, Copenhagen Accord, U.N. Doc. FCCC/CP/2009/L.7 (Dec. 18, 2009) [hereinafter Copenhagen Accord], <http://unfccc.int/resource/docs/2009/cop15/eng/l07.pdf> [<https://perma.cc/238B-KUSD>]; PEW CTR. ON GLOBAL CLIMATE CHANGE, *Fifteenth Session of the Conference of the Parties to the United Nations Framework Convention on Climate Change and Fifth Session of the Meeting of the Parties to the Kyoto Protocol* (2009), <http://www.c2es.org/docUploads/copenhagen-cop15-summary.pdf> [<https://perma.cc/XL8K-36TQ>]; UNFCCC Background, *supra* note 3.

⁴⁶ Ed King, *UN Climate envoys urged to accelerate loss and damage planning*, CLIMATE HOME (June 6, 2013), <http://www.climatechangenews.com/2013/06/05/un-climate-envoys-urged-to-accelerate-loss-and-damage-planning/> [<https://perma.cc/6GVE-395E>]. AOSIS, the Alliance of Small Island States are very concerned that with climate change they will no longer have a home. African countries worry that climate change will change weather patterns endangering their livelihoods.

⁴⁷ Steven Ferrey, *Changing Venue of International Governance and Finance: Exercising Legal Control over the \$100 Billion per Year Climate Fund?*, 30 WIS. INT’L L.J. 26, 26, 30 (2012), <http://hosted.law.wisc.edu/wordpress/wilj/files/2013/01/Ferrey.pdf> [<https://perma.cc/NSZ2-XAPN>].

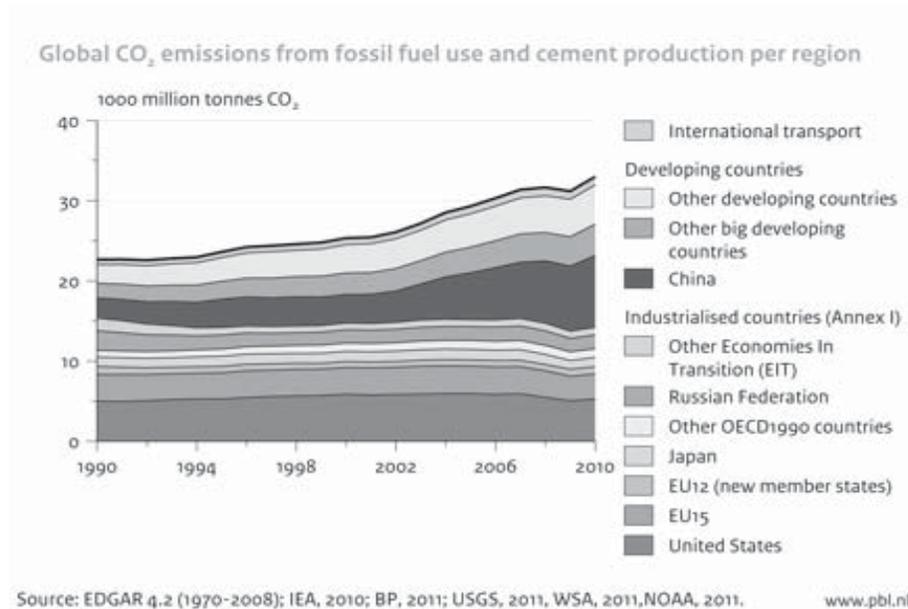
⁴⁸ Jonathan Pickering, *Climate finance: getting to \$100 billion a year by 2020*, DEVPOLICY BLOG FROM THE DEV. POL’Y CNTR. (Nov. 10, 2010), <http://devpolicy.org/climate-finance-getting-to-100-billion-a-year-by-2020-20101110/> [<https://perma.cc/CNU8-4PK4>].

⁴⁹ See generally Pachauri et al., *IPCC, 2014: Climate Change 2014: Synthesis Report*, in CONTRIBUTION OF WORKING GROUPS I, II AND III TO THE FIFTH ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (2014), http://www.ipcc.ch/pdf/assessment-report/ar5/syr/SYR_AR5_FINAL_full.pdf [<https://perma.cc/5EUQ-X9Z5>].

that significant action is needed now, not later, to enact legislation to reduce emission levels, resulting in growing demand for action on domestic and international climate change legislation to significantly reduce GHG emissions.⁵⁰

Given all of the concern for global warming, the IPCC framework as well as COP meetings (including Copenhagen and Durban), it would seem that progress would have been made on reducing emissions, yet globally greenhouse gas emissions continue to increase, see Figure 2.

Figure 2. Rapidly Rising Developing Country Emissions



The global financial crisis of 2008 caused global greenhouse gas emissions to decline by 1% in 2009.⁵¹ However, in 2010 emissions increased

⁵⁰ U.N. Framework Convention on Climate Change art.1, May 9, 1992, 1771 U.N.T.S. 168 (defining “greenhouse gases” as “those gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and re-emit infrared radiation”); see also David G. Duff, *Tax Policy and Global Warming*, 51 CAN. TAX J. 2063, 2065 (2003) (explaining that different gases have different effects on global warming, so emissions are standardized to CO₂ equivalents when measuring their effects on global warming).

⁵¹ J.G.J. Olivier et al., *Long-Term Trend in Global CO₂ Emissions: 2011 report*, PBL NETH. ENVTL. ASSESSMENT AGENCY & JRC EUR. COMM. (Sept. 20, 2011), http://www.pbl.nl/sites/default/files/cms/publicaties/CO2%20Mondiaal_%20webdef_19sept.pdf [<https://perma.cc/D9KA-M6D7>].

by more than 5%, a rate of increase that was unexpected and unseen in two decades.⁵² For the Annex I countries that ratified the Kyoto Protocol, along with the United States (non-ratifying), emissions have declined approximately 7.5% since 1990.⁵³ These countries remain on target to achieve the 5.2% collective reduction by 2012.⁵⁴ However, not anticipated by the creators of Kyoto is how rapidly emissions in developing countries have increased from less than one-third to more than half.⁵⁵

From 2003 until 2010, Chinese CO₂ emissions doubled and Indian emissions increase exceeded 60%.⁵⁶ Chinese emissions grew 10% to 9 billion metric tons in 2010.⁵⁷ India's emission levels rose 9% in 2010 to 1.8 billion metric tons.⁵⁸ Brazil and South Korea emissions rose respectively by 12% and 9%.⁵⁹

B. *Taxing Carbon, Existing and Proposed Policies*

Carbon has been effectively taxed for over twenty years.⁶⁰ While addressing carbon emissions requires the creation and desire to tax carbon, the question to ask is if it will result in emissions declining or is simply an additional source of government revenues.⁶¹ Because of the simplicity of a carbon tax, papers typically discuss some or all of these issues. They are: (a) sectors to include in taxation, (b) the size of tax, (c) usage of the tax revenues, (d) the impact to consumers' wallets and (e) the affect the tax will have on reducing emissions (i.e., price elasticity of demand) and if this will achieve the stated objectives.⁶² The majority of the literature applies a carbon tax to fossil fuels, meaning oil or gasoline, coal and natural gas, which influence for example, the price elasticity of demand.⁶³ Table 1 summarizes existing carbon tax policies.

⁵² *Id.*

⁵³ *Id.*

⁵⁴ *Id.*

⁵⁵ *Id.*

⁵⁶ *Id.*

⁵⁷ Olivier et al., *supra* note 51.

⁵⁸ *Id.*

⁵⁹ *Id.*

⁶⁰ Jenny Sumner et al., *Carbon Taxes: A Review of Experience and Policy Design Considerations*, NAT'L REV. ENERGY LAB (Dec. 2009), <http://www.nrel.gov/docs/fy10osti/47312.pdf> [<https://perma.cc/6XRM-746Z>].

⁶¹ *Id.*

⁶² *Id.*

⁶³ *Id.*

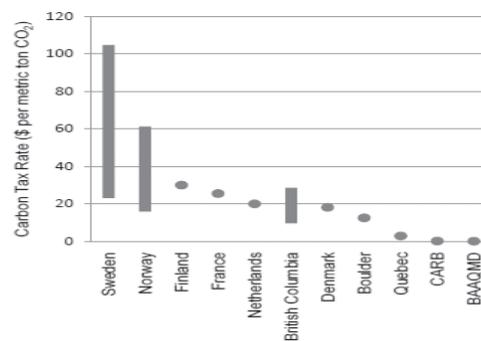
TABLE 1: SUMMARY OF CARBON TAX POLICIES

Country/ Jurisdiction	Start Date	Tax Rate (\$USD unless noted otherwise)	Annual Revenue	Revenue Distribution
Finland	1990	\$30/metric ton CO ₂ (€20)	\$750 million (€500 million)	Government budget; accompanied by independent cuts in income taxes
Netherlands	1990	~\$20/metric ton CO ₂ in 1996	\$4.819 billion ^a (€3.213 billion)	Reductions in other taxes; Climate mitigation programs
Norway	1991	\$15.93 to \$61.76/metric ton CO ₂ (NOK 89 to NOK 345)	\$900 million (1994 estimate)	Government budget
Sweden	1991	Standard rate: \$104.83/metric ton CO ₂ (910 SEK) Industry rate: ~\$23.04/metric ton CO ₂ (~200 SEK)	\$3.665 billion (25 billion SEK)	Government budget
Denmark	1992	\$16.41/metric ton CO ₂ (90 DKK)	\$905 million	Environmental subsidies and returned to industry
United Kingdom	2001	\$0.0078/kWh for electricity; \$0.0027/kWh for natural gas provided by gas utility; \$0.0175/kg for liquefied petroleum gas or other gaseous hydrocarbons supplied in a liquid state; and \$0.0213/kg for solid fuel	\$1.191 billion (£714 million)	Reductions in other taxes
Boulder, CO	2007	\$12-13 per metric ton CO ₂	\$846,885	Climate mitigation programs
Quebec	2007	\$3.20 per metric ton of CO ₂ (C\$3.50)	\$191 million (C\$200 million)	Climate mitigation programs
British Columbia	2008	\$9.55 per metric ton of CO ₂ in 2008 (C\$10), increasing \$4.77 (C\$5) annually to \$28.64 (C\$30) in 2012	\$292 million (C\$306 million)	Reductions in other taxes
BAAQMD, California	2008	\$0.045 per metric ton of CO ₂ e ^b	\$1.1 million (expected)	Climate mitigation programs
France	proposed	\$24.74 per metric ton of CO ₂ (€17)	\$4.499 billion (€3 billion) expected	Reductions in other taxes
CARB, California	proposed	\$0.155 per metric ton CO ₂ e in FY 2010-11, dropping to \$0.09 per metric ton CO ₂ e in 2014	\$63.1 million 2010- 2013; \$36.2 million starting in 2014, expected	Climate mitigation programs

Source: NREL⁶⁴⁶⁴ *Id.*

The tax rates for actual policies, as seen in Table 1, vary widely. Sweden, for example, set its rate to \$105 per metric ton of CO₂, but this rate is substantially less for industry at \$23. Norway taxes gasoline at the equivalent of \$62 per metric ton of CO₂, Finland at \$30. These rates are displayed in Figure 3.

Figure 3. Carbon Tax Rate Policies in U.S. Dollars



Source: NREL⁶⁵

The key question though is do these carbon taxes reduce emissions and if so by how much? How have these actual and proposed policies and their tax rates reduced emissions, and would they be enough to avoid climate change? The Energy Modeling Forum (“EMF”) 16 at Stanford University analyzed projected costs to adhere to Kyoto’s objectives to reduce emissions seven percent below 1990 emissions by 2012.⁶⁶ The results, shown in Table 2 indicate the price range for the models based on whether emissions trading is allowed.⁶⁷ Note that prices from 1990 to 2014 have increased by 88% on a nominal basis.⁶⁸ Therefore, it would be reasonable to assume that these prices are 88% higher in 2014 U.S. Dollars.

⁶⁵ *Id.*

⁶⁶ *Forecasting the Future Value of Carbon: A Literature Review of Mid- to Long-Term Carbon Price Forecasts*, ECOSECURITIES (Jan. 30, 2009), https://www.nwcouncil.org/media/4755/20090130_Carbon_Price_Forecasts_NWPCC_FINAL.pdf [<https://perma.cc/4BDX-UYDV>].

⁶⁷ *Id.*

⁶⁸ Inflation calculator, CALCULATOR.NET, <http://www.calculator.net/inflation-calculator.html?cinterestrates=1&cincompound=1990&cinterestratesout=1.01470&coutcompound=2014&x=87&y=7> [<https://perma.cc/457D-JQTM>]. In order to quickly calculate approximate 2014 prices from estimated 1990 prices, I used the inflation calculator, and discovered a difference of 88%. *Id.*

TABLE 2: STANFORD UNIVERSITY EMF 16 CARBON PRICE FORECASTS

Model	2010 Carbon Price, US\$1990		
	No trading	Annex I trading	Global trading
ABARE-GTEM	87.7	28.9	6.3
AIM	41.7	17.7	10.4
CETA	45.8	12.5	7.1
G-Cubed	20.4	14.4	5.4
MERGE3	71.9	36.8	23.4
MS-MRT	64.3	21.0	7.4
RICE	51.2	16.9	4.9
Median	51.2	16.9	7.1

Source: NW Council⁶⁹

The Center for Climate and Energy Solutions modeled the Lieberman-Warner Climate Security Act of 2008 to understand the expenses required to achieve the goals set forth in the bill.⁷⁰

TABLE 3: LIEBERMAN-WARNER IMPLEMENTATION COSTS, PEW CENTER CARBON PRICE FORECASTS

Modeling Exercise	2020		2030		2050	
	Allowance Price (2005\$)	GDP Impact (% change from BAU)	Allowance Price (2005\$)	GDP Impact (% change from BAU)	Allowance Price (2005\$)	GDP Impact (% change from BAU)
EIA-Core Scenario	\$29	-0.27%	\$59	-0.29%	—	—
CATF	\$22	-0.5%	\$48	-0.69%	—	—
ACCF/NAM-Low Cost	\$52	-0.8%	\$216	-2.60%	—	—
ACCF/NAM-High Cost	\$61	-1.1%	\$257	-2.70%	—	—
MIT-Offsets + CCS	\$58	-0.8%	\$86	-0.38%	\$189	-0.75%
EPA (ADAGE)-Scenario 2	\$37	-0.7%	\$61	-0.90%	\$159	-2.37%
EPA (ADAGE)-Scenario 10	\$28	-0.5%	\$46	-0.59%	\$121	-1.76%
CRA-Scenario with Banking	\$58	-1.5%	\$84	-1.40%	\$185	-2.70%

Source: Center for Climate and Energy Solutions. Analysis of the Lieberman-Warner Climate Security Act of 2008.⁷¹

⁶⁹ ECOSECURITIES, *supra* note 66.

⁷⁰ *Analysis of the Lieberman-Warner Climate Security Act of 2008*, CTR. FOR CLIMATE & ENERGY SOLUTIONS, <http://www.c2es.org/federal/congress/110/liberman-warner-climate-security-act-2008> [<https://perma.cc/QZ2W-7PMZ>].

⁷¹ *Insights from Modeling Analyses of the Lieberman-Warner Climate Security Act* (S. 2191), PEW CTR. ON GLOBAL CLIMATE CHANGE (May 2008), <http://www.c2es.org/docUploads/L>

As can be seen the price estimates are \$22 to \$61 per ton by 2020, increasing to \$48 to \$257 per ton by 2030 and range from \$121 to \$189 by 2050. The goal under S. 2191 was to reduce U.S. emissions 40% by 2030 (from 2005 levels, a reduction of 11% from 1990 levels) and 56% by 2050 (from 2005 levels, a reduction of 25% below 1990 levels).⁷² The “business as usual” (“BAU”) calculations show the potential impact to GDP. These costs are very significant but consistent with the theory that demand for energy is inelastic and the price for elasticity of demand is proof of this. The Heritage Foundation proceeded to examine the costs of the Waxman-Markey Bill.⁷³ Their analysis of this Bill shows the price of carbon will exceed \$120 per ton of CO₂ by 2035.⁷⁴ Annual GDP losses are forecast to exceed \$600 billion per year.⁷⁵ The projected reductions in emissions were 3% by 2012 (from 2005 levels) and 83% by 2050.⁷⁶

Put simply, a program to tax or cap carbon that focuses solely on demand will result in a very high tax rate to dissuade consumers from using carbon intensive products (energy and power). In addition, note, just because a carbon tax is implemented does not mean that emissions will actually decline. Norway, which implemented a carbon tax in 1991, saw emissions increase by 15% from 1991 to 2008 and received negative press because of this.⁷⁷ However, Norway also experienced a 70% increase in GDP.⁷⁸ So although Norway learned to use energy much more efficiently on a per dollar GDP basis,⁷⁹ because its energy sources did not change, its total emissions increased.

-W-Modeling.pdf [https://perma.cc/5ABC-BSPS].

⁷² *EPA Analysis of the Lieberman-Warner Climate Security Act of 2008: S. 2191 in 110th Congress*, ENVTL. PROT. AGENCY (Mar. 14, 2008), http://www3.epa.gov/climatechange/Downloads/EPAactivities/s2191_EPA_Analysis.pdf [https://perma.cc/75TZ-B8GX].

⁷³ William W. Beach et al., *The Economic Consequences of Waxman-Markey: An Analysis of the American Clean Energy and Security Act of 2009*, THE HERITAGE FOUND. (Aug. 6, 2009), <http://www.heritage.org/research/reports/2009/08/the-economic-consequences-of-waxman-markey-an-analysis-of-the-american-clean-energy-and-security-act-of-2009> [https://perma.cc/6LB9-78NK].

⁷⁴ *Id.*

⁷⁵ *Id.*

⁷⁶ *Id.*

⁷⁷ Leila Abboud, *An exhausting war on emissions: Norway's efforts to contain greenhouse gases move forward—and backfire*, WALL STREET J., (Sept. 30, 2008), available at <http://online.wsj.com/article/SB122272533893187737.html> [https://perma.cc/W9FB-2EHN].

⁷⁸ *Id.*

⁷⁹ If GDP increased from 100 to 170 and emissions increased from 100 to 115, this means the same energy unit produced 47.8% more GDP ($170/115 = 1.478$), resulting in an economy that was 32.4% more energy efficient ($1 - 115/170 = 32.4\%$).

C. *European Unilateralism: A Special Case*

Seeking to show the world how to move forward and frustrated with the international community's progress on reducing global emissions, the EU set up the EU-ETS in 2005, with the stated goal of reducing global emissions.⁸⁰ The EU-ETS (cap and trade) was structured to minimize GHGs from 'deemed' polluting industries (electricity providers, cement plants, iron and steel factories and refineries)⁸¹ throughout Europe.⁸² Europe set out to develop and sustain a carbon marketplace that would incentivize financing low or no carbon technologies.⁸³ Hailed as a large success when implemented, it has not succeeded in achieving its objectives.⁸⁴ The EU-ETS has resulted in poor economic efficiency and unrealized environmental goals since its inception,⁸⁵ and great concern that many European Parliament Members ("MEPs") are ready to bail on the EU-ETS.⁸⁶ The European Parliament rejected on April 16, 2013 a measure that would have bolstered the faltering program,⁸⁷ leading to new lows in the carbon market price for allowances.⁸⁸ This not only has consequences for trade but also is bad for the European economy, which has become increasingly dependent on energy and infrastructure.⁸⁹ It seems that the EU-ETS is faltering and will fail to achieve its objective. Because the structure does not create certainty for industry and consumers, no one is able to plan for the future as prices gyrate too often as seen in Figure 4, which shows this instability due to over-allocating allowances for emissions within the EU-ETS.⁹⁰

⁸⁰ A. Denny Ellerman, *THE EUROPEAN UNION'S EMISSIONS TRADING SYSTEM IN PERSPECTIVE* ii-3 (2008).

⁸¹ Julien Chevallier, *Banking and Borrowing in the EU ETS: A Review of Economic Modelling, Current Provisions and Prospects for Future Design*, 26 J. ECON. SURV. 158, 158-63 (2012).

⁸² Ricardo Coelho et al., *Green is the Color of Money: The EU ETS Failed Model for the "Green Economy"*, 173 CARBON TRADE WATCH 1, 1 (2013).

⁸³ *Id.*

⁸⁴ *Id.*

⁸⁵ See Anna Petherick, *Holding Out Hope*, 3 NATURE CLIMATE CHANGE 534, 534 (2013).

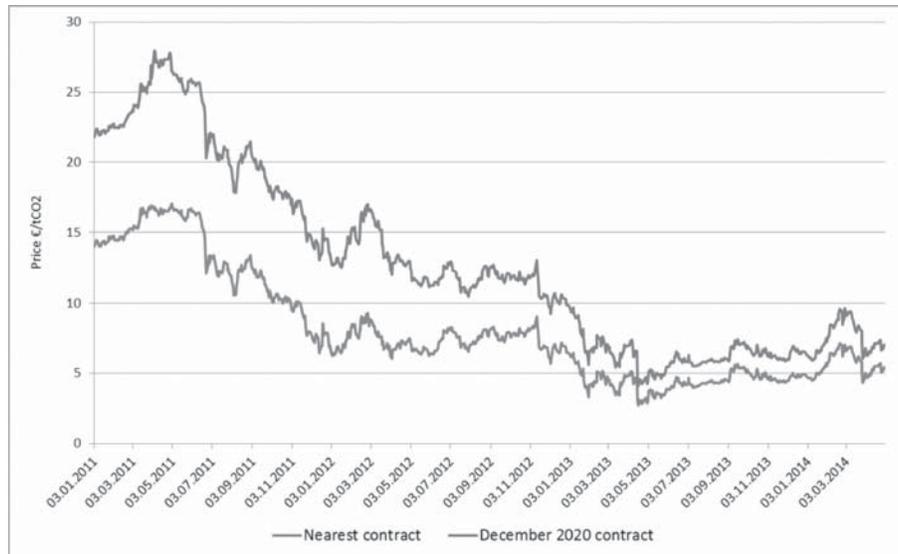
⁸⁶ *Carbon Trading: ETS RIP?*, ECONOMIST, Apr. 2013.

⁸⁷ *Id.*

⁸⁸ *Id.*

⁸⁹ See David Victor & Linda Yueh, *The New Energy Order*, 89 FOREIGN AFF. 25, 26 (2010).

⁹⁰ Alex Scott, *EU Carbon Emissions Trading Scheme in Freefall*, CHEMICAL & ENG'G NEWS (Feb. 18, 2013), <http://cen.acs.org/articles/91/i7/EU-Carbon-Emissions-Trading-Scheme.html> [<https://perma.cc/X2BH-DWDX>].

Figure 4. Price Instability in the EU-ETS

Source: ICE Futures Europe (Note on graph: The top line represents the December 2020 contract, and the bottom line represents the Nearest contract.)

Because of these price gyrations and declines in the EU-ETS, Europe's coal consumption increased⁹¹ due to Europe being very dependent on Russian gas.⁹² Coal, as an available and viable alternative to Russian gas, might increase further to minimize this dependence due to the uncertainty of Russian supplies in good times⁹³ (Russia cut off supplies

⁹¹ *Europe's dirty secret: The unwelcome renaissance*, *ECONOMIST*, Jan. 5, 2013, <http://www.economist.com/news/briefing/21569039-europes-energy-policy-delivers-worst-all-possible-worlds-unwelcome-renaissance> [<https://perma.cc/QCL4-SP26>].

⁹² Kit Gillet McClatchy, *Europe fears its dependency on Russian natural gas as U.S., EU sanctions near*, *MIAMI HERALD*, Mar. 16, 2014, <http://www.miamiherald.com/2014/03/16/3998968/europe-fears-its-dependency-on.html> [<https://perma.cc/384Y-CQ47>].

⁹³ EDWARD CHOW & ANNE HUDSON, *CTR. STRATEGIC INTL. STUDIES, THE RUSSIA-EU GAS RELATIONSHIP: A PARTNERSHIP OF NECESSITY* (2013), <https://csis.org/publication/russia-eu-gas-relationship-partnership-necessity> [<https://perma.cc/6MXL-NVJ9>].

in 2006 and 2009). Greater uncertainty has arisen given the political tensions caused by the invasion of Crimea in the Ukraine⁹⁴ and the takeover of a major natural gas station.⁹⁵

I. CARBON TAX ELEMENTS

A. *Development of Policy to Tax Carbon*

As noted originally, the objective of this Article is to set up an innovative policy that taxes carbon, which results in massive reductions of emissions and examines the results and implications of achieving this objective in economic terms specifically for U.S. households. Policy makers, economists, and lawyers have all proposed taxing carbon in one manner or another. The key challenge, as Pindyck⁹⁶ stated, is how do we price carbon when the reality is we do not know the correct price? All policy developers generally concur with Pigou,⁹⁷ Baumol⁹⁸ and Coase⁹⁹ that emissions are an externality. That this externality (i.e., pollution, global warming, and climate change) is caused by anthropogenic emissions¹⁰⁰ and has resulted in a social cost. Moreover, that the best way to address

⁹⁴ Anthony Faiola & Will England, *Ukraine denounces 'invasion' by Russian forces on eve of Crimea's referendum*, WASHINGTON POST, Mar. 15, 2014, available at http://www.washingtonpost.com/world/europe/tensions-mount-as-crimea-prepares-for-referendum/2014/03/15/a384c36a-ac40-11e3-a06a-e3230a43d6cb_story.html [<https://perma.cc/FN5T-NSUS>].

⁹⁵ Doug Schoen, *With Takeover of Natural Gas Station, Russia Ratchets Up Tension With Ukraine*, FORBES, Mar. 16, 2014, available at <http://www.forbes.com/sites/dougschoen/2014/03/16/russia-invades-ukraine/> [<https://perma.cc/4H82-TYBH>].

⁹⁶ Robert S. Pindyck, *Pricing Carbon When We Don't Know the Right Price*, REGULATION 43–46 (2013).

⁹⁷ See ARTHUR CECIL PIGOU, *THE ECONOMICS OF WELFARE* 192–93 (Transaction Publishers 2002) (4th ed., rev. prt. 1952). For a review of the theory behind environmental taxes, see A. Lans Bovenberg & Lawrence H. Goulder, *Environmental Taxation and Regulation*, 3 HANDBOOK OF PUB. ECON. 1471 (Alan J. Auerbach & Martin Feldstein eds., 2002). Several papers consider design issues from a general perspective, such as how to set the tax when there are administrative costs of collection. See, e.g., A. Mitchell Polinsky & Steven Shavell, *Pigouvian Taxation with Administrative Costs*, 19 J. PUS. ECON. 385 (1982).

⁹⁸ William J. Baumol, *On taxation and the control of externalities*, 62 AM. ECON. REV. 307–22 (1972).

⁹⁹ R. H. Coase, *The Problem with Social Costs*, 3 J. L. & ECON. 1–44 (1960).

¹⁰⁰ For a list of GHGs, see Susan Solomon et al., *Technical Summary: Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, in CLIMATE CHANGE 2007: THE PHYSICAL SCIENCE BASIS (2007), https://www.ipcc.ch/publications_and_data/ar4/wg1/en/spm.html [<https://perma.cc/T4H5-UAGX>].

the externalities caused by these emissions is to tax them, thereby internalizing the costs. Without internalizing costs, consumers are receiving the wrong price signals (goods and services are too cheap)¹⁰¹ and over-consuming as a result.¹⁰²

Taxing carbon (GHG emissions), increases the price of goods, leads to reduced consumption (due to higher prices), and encourages producers to either reduce output and/or produce more efficiently (less emissions per good), which will be followed by a reduction in associated emissions. This decreases the social costs and associated impact of climate change.¹⁰³ Multiple papers exist that discuss how to develop or design a carbon tax; Metcalf and Weisbach believe that most of these are limited in scope and poorly designed.¹⁰⁴ Further, they note that some of these proposals have been introduced in Congress, but have not been passed.¹⁰⁵

The majority of carbon tax papers (the majority of which examine the United States) fail to address 100% of emissions, including Metcalf and Weisbach,¹⁰⁶ Waggoner,¹⁰⁷ Bryner,¹⁰⁸ and many others.¹⁰⁹ These authors are uncertain as to the actual reduction in U.S. emissions from applying the carbon tax, and therefore are unsure of the impact on consumers.¹¹⁰

¹⁰¹ All goods and services will be referred to as goods.

¹⁰² Gilbert E. Metcalf & David Weisbach, *The Design of a Carbon Tax*, 33 HARV. ENVTL. L. REV. 499 (2009).

¹⁰³ *Id.*

¹⁰⁴ *Id.*

¹⁰⁵ During the 10th Congress, the House introduced two bills. See Save Our Climate Act of 2007, H.R. 2069, 110th Cong. (2007); America's Energy Security Trust Fund Act of 2007, H.R. 3416, 110th Cong. (2007). Rep. John Dingell also put forth a proposal but did not actually introduce it. In the current session of the 111th Congress, H.R. 3416 has been reintroduced. See America's Energy Security Trust Fund Act of 2009, H.R. 1337, 111th Cong. (2009).

¹⁰⁶ Metcalf & Weisbach, *supra* note 102.

¹⁰⁷ Michael J. Waggoner, *The House Erred: A Carbon Tax is Better than Cap and Trade*, 124 TAX NOTES 1257 (2009).

¹⁰⁸ Gary Bryner, *Reducing Greenhouse Gases Through Carbon Market*, 85 DENV. U. L. REV. 961, 969 (2008) (discussing cap-and-trade approaches to reducing greenhouse gas emissions).

¹⁰⁹ James M. Poterba, *Tax Policy To Combat Global Warming: On Designing a Carbon Tax*, MIT CTR. FOR ENERGY POLY RESEARCH (outlining the design of a carbon tax in March 1991), available at <http://dspace.mit.edu/bitstream/handle/1721.1/50159/28596145.pdf?sequ> [<https://perma.cc/6LFA-XXPS>] (last visited Mar. 20, 2016).

¹¹⁰ Jonathan Ramseur & Larry Parker, *Carbon Tax and Greenhouse Gas Control: Options and Considerations*, CONG. RESEARCH SERV. (Mar. 10, 2009) available at <https://www.fas.org/sgp/crs/misc/R40242.pdf> [<https://perma.cc/BB87-3DP3>].

Returning to Pindyck, the key challenge all papers examining the law and/or economics of a carbon tax face is trying to determine the exact price for carbon.¹¹¹ This is because a carbon tax affects the price of goods, meaning it increases their prices. Using an economic concept—the price elasticity of demand¹¹²—consumption declines, resulting in declining emissions. The key assumption here is that consumers cannot switch to goods that are not taxed, i.e. imports, and that alternative goods will be supplied to the market that are either produced with fewer emissions or their consumption results in lower emissions.¹¹³

Because of the importance of the price elasticity of demand, it is necessary to explain this concept, which is rarely (if ever) explained in these types of articles.

B. *Price Elasticity of Demand*

The price elasticity of demand (“Ped”) is a key concept to understand in order to design a carbon tax and present how the tax influences total emissions. To calculate the Ped, it is necessary to take the percentage change in quantity demanded and divide by the percentage change in price.¹¹⁴ If Ped=0, this means demand is perfectly inelastic, meaning demand does not change no matter how high or low the price.¹¹⁵ If Ped is between 0 and 1 ($0 < \text{Ped} < 1$), demand is considered to be inelastic as shown in Figure 5a.¹¹⁶ This means that a price change of say 10% (price increases by 10%) will lead to a less than 10% decrease in quantity demanded (consumed).¹¹⁷ These are shown in Figure 5:

¹¹¹ See Pindyck, *supra* note 96, at 43–46.

¹¹² James Peck, *Principles of Microeconomics: Elasticity*, OHIO STATE DEP’T OF ECON., <http://www.econ.ohio-state.edu/jpeck/H200/EconH200L5.pdf> [<https://perma.cc/GL26-YX7V>] (last visited Mar. 20, 2016) (explaining microeconomic theory and calculations of price elasticity of demand).

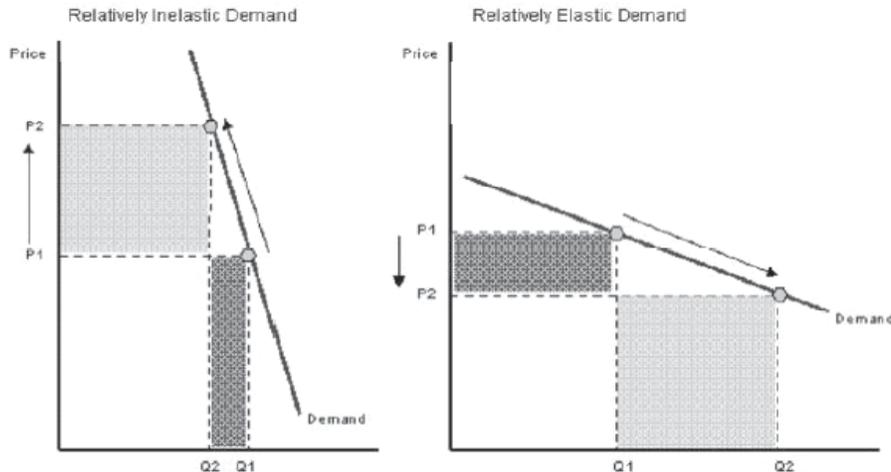
¹¹³ Gaurav Akrani, *Demand in Economics—Law of Demand—Elasticity of Demand*, KALYAN CITY LIFE (Aug. 26, 2009), <http://kalyan-city.blogspot.com/2009/08/demand-price-law-of-demand-determinants.html> [<https://perma.cc/E3X2-KHUL>].

¹¹⁴ Peck, *supra* note 112.

¹¹⁵ *Inelastic*, INVESTOPEDIA, <http://www.investopedia.com/terms/e/inelastic.asp> [<https://perma.cc/HLU4-HNV3>] (last visited Mar. 20, 2016).

¹¹⁶ Peck, *supra* note 112.

¹¹⁷ *Elasticity*, ECON. TUITION SINGAPORE (Jan. 27, 2014), <http://www.econs.com.sg/free-downloads/elasticity/> [<https://perma.cc/YU7Z-CJSM>].

Figure 5. Price Elasticity—Inelastic and Elastic Demand

If P_{ed} is 1 then demand is considered to be unit elastic, meaning a 10% increase in price results in a 10% reduction in quantity consumed.¹¹⁸ And if P_{ed} is > 1 , then demand is considered to be elastic, meaning a 10% increase in price results in a more than 10% reduction in consumption.¹¹⁹ The opposite happens if price decreases.¹²⁰

This is important to understand because energy in general is considered price inelastic especially in periods of less than one year (considered short run).¹²¹ They are still inelastic in the long run (more than one year), but less so.¹²² This is illustrated below in Figure 6 by comparing summer consumption of gasoline from 2000 to 2012 with retail prices:

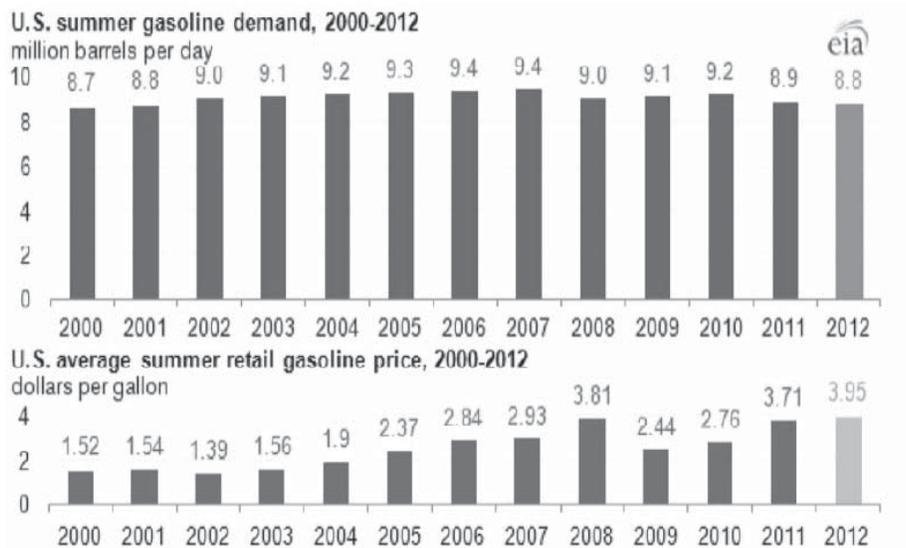
¹¹⁸ Peck, *supra* note 112.

¹¹⁹ ECON. TUITION SINGAPORE, *supra* note 117.

¹²⁰ *Id.*

¹²¹ Aaron Menenberg, *Why Energy Demand Grows with the Economy*, ECONOMONITOR (Sept. 28, 2012), <http://www.economonitor.com/policiesofscale/2012/09/28/why-energy-demand-grows-with-the-economy/> [<https://perma.cc/RM4Y-LT4F>].

¹²² *Id.*

Figure 6. U.S. Summer Gasoline Demand and Prices, 2000–12

Source: U.S. Energy Information Administration, Short-Term Energy Outlook (“STEO”),¹²³ April 10, 2012.¹²⁴ Note: The 2012 figures for summer gasoline demand and retail gasoline prices are projections from EIA’s Short-Term Energy Outlook.¹²⁵

While there are well over 100 studies of the price elasticity of demand, I examined gasoline meta-data research, which determined gasoline’s price elasticity of demand. Espey compared 101 different studies for the United States in the short run (less than one year) price elasticity of demand, which is -0.26; this implies a 10% price increase leads to a 2.6% reduction in quantity demand.¹²⁶ However, as all markets are always more price elastic in the long run, she determined price elasticity of demand is -0.58, implying a 10% price increase results in a 5.8% reduction

¹²³ *Short-Term Energy and Summer Fuels Outlook*, U.S. ENERGY INFO. ADMIN. (Mar. 11, 2014), available at <http://www.eia.gov/forecasts/steo/> [<https://perma.cc/4RCD-6GB7>].

¹²⁴ *Today in Energy*, U.S. ENERGY INFO. ADMIN. (Apr. 26, 2012), <https://www.eia.gov/todayinenergy/detail.cfm?id=6010> [<https://perma.cc/KC23-ZCAH>].

¹²⁵ *Id.*

¹²⁶ Molly Espey, *Explaining the Variation in Elasticity Estimates of Gasoline Demand in the United States: A Meta-Analysis*, 17 ENERGY J. 49, 60 (1996).

in quantity demand.¹²⁷ In the long run, customers adjust by changing vehicles and driving less.¹²⁸ A similar study was conducted in the UK¹²⁹ that produced price elasticity of demand to be -0.25 and -0.77, meaning a 10% increase in prices results of -.025 and -.077.¹³⁰ Note: if incomes increase this may offset a price increase.¹³¹ The price refers to the real, not nominal (or inflated) price.¹³²

Gasoline, in fact, is one of the most heavily taxed carbon products in the world.¹³³ Out of 155 countries surveyed, the United States had the 44th cheapest gas prices on July 15, 2008.¹³⁴ While U.S. consumers were paying \$3.45 per gallon, consumers in Eritrea paid \$9.58, Norway \$8.73, Germany \$7.86, Kuwait \$0.90, Saudi Arabia \$0.45, and Venezuela \$0.12 per gallon.¹³⁵ The difference in prices is dependent on government taxation or subsidies.¹³⁶

This concept is critical to understanding that applying carbon taxes to the demand side alone will not solve climate change. At present, there are few substitutes for gasoline, and simply taxing energy only increases the costs of alternatives, it does not promote or encourage substitution to lower-emission sources of energy.

C. Sources of Emissions

For the successful implementation of a tax, it will be necessary to ensure that relatively accurate country stocks of GHGs (sources and

¹²⁷ *Id.*

¹²⁸ *Id.*

¹²⁹ See Mark Hanly, Joyce Dargay, and Phil Goodwin, *Review of Income Elasticities and the Demand for Road Traffic*, CENTRE FOR TRANSPORT STUD., 1 (Mar. 2002), <http://www.tcd.ie/Economics/msceps/courses/understanding%20markets/12a.%20Income%20elasticity%20and%20road%20traffic%20UK.pdf> [<https://perma.cc/6M6V-KS5C>].

¹³⁰ Phil Goodwin, Joyce Dargay, & Mark Hanly, *Elasticities of Road Traffic and Fuel Consumption with Respect to Price and Income: A Review*, 24 *TRANSPORT REVS.* 261, 270 (2004).

¹³¹ *Id.* at 272.

¹³² *Real vs. Nominal*, WHATISECONOMICS, <http://www.whatiseconomics.org/macroeconomics/real-vs-nominal> [<https://perma.cc/RN2W-4DW9>] (last visited Mar. 20, 2016).

¹³³ Brad Plumer, *The U.S. has some of the lowest energy taxes in the developed world*, WASHINGTON POST WONKBLOG (Jan. 31, 2013) <https://www.washingtonpost.com/news/wonk/wp/2013/01/31/how-the-world-taxes-fossil-fuels-in-three-charts/> [<https://perma.cc/9KAD-FULN>].

¹³⁴ Steve Hargreaves, *U.S. Gas: So cheap it hurts*, CNN (July 15, 2008), http://money.cnn.com/2008/05/01/news/international/usgas_price/ [<https://perma.cc/86YN-Z5D2>].

¹³⁵ *Id.*

¹³⁶ *Id.*

sinks) are determined. This data seems reasonably available, as Figure 2 shows. In 2011, the U.S. Environmental Protection Agency (“EPA”)¹³⁷ prepared a report titled “Inventory of U.S. Greenhouse Gas Emissions and Sinks” stating that the United States emitted carbon dioxide equivalents of roughly 6.7 billion metric tons.¹³⁸ An amount roughly equal to approximately 19% of total worldwide emissions, excluding those from land change.¹³⁹

Four sectors generate the majority of emissions.¹⁴⁰ Three of these sectors burn fossil fuels.¹⁴¹ The three are: (1) utilities and industry, (2) transportation, and (3) buildings (commercial and residential).¹⁴² Utilities produce GHG by using carbon-based fuels to generate electricity used by the other sectors.¹⁴³ The EPA then allocates the emissions from generation of electricity to sectors using the power.¹⁴⁴ To do this, the EPA allocates based on carbon intensity and mix of fuels used.¹⁴⁵ After allocation the distribution of emissions utilities/industry, transportation and buildings is 26.1%, 34.1% and 39.8% respectively.¹⁴⁶ Prior to these allocations, the utilities/industry sector is responsible for 57% of total emissions, transportation for 32% (need to transfer 2.7% for street signals and lights, etc.) and building sector only represents 11% of total emissions as it does burn natural gas (heating and hot water) along with some other fuels, such as diesel.¹⁴⁷ The utilities/industry sector is the primary concern, given that it is the leading generator of GHG emissions.¹⁴⁸ The fourth

¹³⁷ See *Trends in Greenhouse Gas Emissions*, EPA, available at <http://www.epa.gov/climatechange/ghgemissions/usinventoryreport.html> [<https://perma.cc/4YXJ-QD3X>].

¹³⁸ *Climate Change Indicators in the United States: U.S. Greenhouse Gas Emissions*, EPA, <http://www3.epa.gov/climatechange/science/indicators/ghg/us-ghg-emissions.html> [<https://perma.cc/4D7S-FB7N>] (last visited Mar. 20, 2016).

¹³⁹ *Global Emissions Greenhouse Gas Data*, EPA, <http://www.epa.gov/climatechange/ghgemissions/usinventoryreport.html> [<https://perma.cc/WDR6-PE3S>] (last visited Mar. 20, 2016).

¹⁴⁰ *Id.*

¹⁴¹ *Id.*

¹⁴² *Id.*

¹⁴³ *Emissions of Greenhouse Gases in the U.S.*, U.S. ENERGY INFO. ADMIN. (Mar. 31, 2011), http://www.eia.gov/environment/emissions/ghg_report/ghg_overview.cfm [<https://perma.cc/YJ5S-G27K>].

¹⁴⁴ *Id.*

¹⁴⁵ *Id.*

¹⁴⁶ *Id.*

¹⁴⁷ *Inventory of U.S. Greenhouse Gas Emissions and Sinks*, EPA (Apr. 15, 2012), <http://www3.epa.gov/climatechange/Downloads/ghgemissions/US-GHG-Inventory-2012-Main-Text.pdf> [<https://perma.cc/WTA2-6499>].

¹⁴⁸ *Id.*

area is Land Use, Land-Use Change and Forestry (“LULUCF”), a very important sector for other countries.¹⁴⁹

In order to control and limit global emissions, it is necessary to include LULUCF emissions, especially in realizing the amount of carbon contained in imports due to LULUCF.¹⁵⁰ These are important to solving climate change mitigation.¹⁵¹ The agricultural sector or Land Use (“LU”) is responsible for approximately 14% of global anthropogenic GHG emissions.¹⁵² LU will continue to have a high rate of growth unless controlled, due to increasing populations and rising incomes.¹⁵³ Land-Use Change and Deforestation (“LUCF”) accounts for an additional 17% of total emissions.¹⁵⁴ Combined, these two sectors (“LULUCF”) account for 31% of total worldwide emissions.¹⁵⁵ Using Brazil as an example, once LULUCF emissions are included, the country is one of the largest global emitters of GHGs.¹⁵⁶ For example, in 1994 LULUCF accounted for 55% of total Brazilian GHG emissions, which totaled 1.7 billion metric tons.¹⁵⁷ Brazilian action on reducing LULUCF is critical to saving the Amazon, which represents 40% of remaining global rainforest.¹⁵⁸ A properly structured tax would include these emissions in calculating the tax on Brazilian imports, ensuring that Brazil would be eager to take action to reduce their GHG emissions, or they could likely find that their manufactured goods and mineral exports may end up not being competitive on the world market.

Understanding these four areas of emissions is critical to developing a carbon tax that will address, and therefore reduce, global emissions.

¹⁴⁹ See generally *Land Use, Land-Use Change and Forestry Sector Emissions*, EPA, <http://www3.epa.gov/climatechange/ghgemissions/sources/lulucf.html> [https://perma.cc/653Y-DQMH] (last visited Mar. 20, 2016).

¹⁵⁰ *Id.*

¹⁵¹ *Id.*

¹⁵² Carlos Cerri et al., *Brazilian greenhouse gas emissions: the importance of agriculture and livestock*, 66 *SCIENTIA AGRICOLA* 831, 832 (2009) available at <http://www.scielo.br/pdf/sa/v66n6/a17v66n6.pdf> [https://perma.cc/9DSK-DWA7].

¹⁵³ Lenny Bernstein et al., *Climate Change 2007: Synthesis Report*, INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE 14, 37 (2008).

¹⁵⁴ Cerri et al., *supra* note 152, at 832.

¹⁵⁵ *Id.*

¹⁵⁶ *Id.*

¹⁵⁷ *Id.*

¹⁵⁸ Hans-Peter Meister et al., *Floating Houses and Mosquito Nets: Emerging Climate Change Adaptation Strategies Around the World*, MEISTER CONSULTANTS GP. at 76 (2009), available at http://www.forestclim.eu/fileadmin/Bilder/Dokumente/IFOK_2010_Emerging_Climate_Change_Strategies_Around_the_World.pdf [https://perma.cc/R5PV-NVMU].

II. CARBON TAX DESIGN

To design this carbon tax strategy, I considered all of the required variables. These include: (a) which sectors to tax (all); (b) the tax rate (certainty); (c) tax revenue use (reinvestment); (d) consumer impact; and (e) the affect the tax will have on reducing emissions; and (f) if this will achieve the objectives set to reduce emissions to prevent the globe from warming by more than 2°C.

A. *Sectors to Tax*

As discussed in the previous section, there are four primary sectors. These are utilities/industry, buildings (commercial and residential), transportation, and LULUCF. Concerning the tax base, it is necessary that all emissions are included. This all-inclusive tax collects the funding downstream on all goods and services; this structure encourages everyone to support low carbon emission power plants/industry, buildings, and transportation, as well as minimize LULUCF.¹⁵⁹ Unlike other proposals, there are no winners or losers, per se. Through 2011, the EU-ETS cost the EU economy \$287 billion, according to UBS Investment Research, and the result was “almost zero impact” on the total GHG emissions within the EU.¹⁶⁰ Rather than simply reallocate monies, if the EU had spent the same amount of funds to replace or upgrade existing power plants and improve energy efficiency, emissions could have been lowered upwards of 40% in the EU.¹⁶¹ In the scheme I developed, all goods and services, that is 100% of emissions (United States, EU, China, etc.) are taxed. The tax is based on carbon emissions intensity and is collected downstream, not upstream as Metcalf and Gilbert,¹⁶² Waggoner¹⁶³ and many other carbon tax papers purport. It is anticipated that tax collection costs will be low as the tax is collected alongside the sales tax that exists in forty-five U.S. states.¹⁶⁴ The tax as explained in Section IV is collected

¹⁵⁹ This structure results in collecting carbon taxes on 100% of a country's carbon emissions.

¹⁶⁰ Sid Maher, *Europe's \$287bn carbon 'waste': UBS report*, THE AUSTRALIAN, Nov. 23, 2011, available at <http://www.theaustralian.com.au/national-affairs/europes-287bn-carbon-waste-ubs-report/story-fn59niix-1226203068972> [<https://perma.cc/YSA3-H4DT>].

¹⁶¹ *Id.*

¹⁶² Metcalf & Weisbach, *supra* note 102.

¹⁶³ Michael J. Waggoner, *Why and How to Tax Carbon*, 20 COLO. J. INT'L ENVTL. L. & POL'Y 1, 1 (2008).

¹⁶⁴ *State-by-state Guide to Taxes on Retires*, KIPLINGER (2013), available at <http://www.kiplinger.com/tool/retirement/T055-S001-state-by-state-guide-to-taxes-on-retirees>

using country-level emissions intensity for all goods and services.¹⁶⁵ Unlike in other carbon tax (design) papers, there is no tax credit or offset provided to fossil fuels that have not been consumed or burned.

To further simplify matters, this tax is simple in design. For example, it uses the value of asphalt (as with any other good or service) to calculate a carbon tax using a standard emissions intensity,¹⁶⁶ rather than complicate matters and debate if distillates are sequestered into asphalt or emitted as proposed by other authors.¹⁶⁷ This is done to discourage the use of goods produced with our current energy systems, as it is not the asphalt's fault that it is a dirty but effective cheap road building technology. Rather, it is contingent on all of the people within each country to demand clean technology, making everyone essentially responsible for using that country's current (dirty) technologies. Therefore, the intent of this carbon tax design is to create a tax that taxes all emissions generated or created in a state, country or region, by using emissions intensity, which implies taking the total of all emissions divided by GDP. This would therefore encourage more efficient operations economy-wide by taxing all goods and services (including agricultural). Additionally, there is the demand-side impact of a carbon tax, which occurs by increasing prices, even if slightly, thereby giving us price signals and encouraging us to create less carbon (consuming goods and services with less carbon).

Under this carbon tax regime, if Brazil continued to deforest thereby emitting large amounts of GHG emissions, it would soon find that with border tax adjustments ("BTA") in place using the same emissions intensity structure, its exports of manufactured goods, services and energy would be non-competitive in the world marketplace. Within my model, I developed a guideline that LULUCF emissions are cumulative. This means that once the baseline year is set (be it 1990, 2005 or 2012), any

/index.php?map=2 [https://perma.cc/SMQ2-UXP5]. Note, Alaska and Montana have local counties that add a local sales tax, but it is not collected state wide.

¹⁶⁵ Emissions intensity is the level of emissions produced per \$1000 of GDP (gross domestic product). As an example, if the U.S. economy produces \$15 trillion in GDP and releases six billion tons of carbon emissions equivalent, then the rate is \$2,500 of GDP produced per one ton of carbon emissions. A \$50 tax per ton of emissions would be the equivalent of a \$50 tax on \$2500 worth of U.S. goods and services, which is equivalent to 2% tax rate ($\$50/\$2500 = 2\%$). Therefore, a \$25,000 car would be taxed \$500 (2%), the same with \$25,000 of services. The concept being all citizens based on their choices and consumption are responsible for the country's emissions. Giving a stake provides incentivizes everyone to encourage the reduction of total emissions.

¹⁶⁶ *Id.*

¹⁶⁷ Metcalf & Weisbach, *supra* note 102.

LULUCF emissions after this period are cumulative until the damage is repaired.¹⁶⁸ Brazilian emissions including LULUCF (as well as forest intensity)¹⁶⁹ results in a very high emissions intensity rate, that will impact exports encouraging a vast majority of Brazilians to not only be opposed to those cutting down the Amazon forest,¹⁷⁰ but to take political action to ensure the deforestation stops. The incentive from using emissions intensity to tax imports would lead to areas that were deforested being reforested as quickly as possible for a country to regain its competitive position in the international marketplace. This structure would also lead to less carbon intensive agricultural practices. The structure of this carbon tax is purposeful to create large majorities from all political parties, industry, unions, etc. to join forces to combat climate change against the few who create large sources of emissions, thereby rendering a country uncompetitive in global trade.¹⁷¹

B. *The Tax Rate*

The tax rate is set low to begin with and the increases are predetermined in order to have the greatest impact at reducing total emissions.¹⁷² There were several objectives to creating this structure. First, setting the initial rate low would make it more politically acceptable and signal to consumers and producers a need to change. Because the tax is used to build power plants, it is also necessary that the construction and manufacturing industries have time to ramp up production.¹⁷³ This avoids

¹⁶⁸ Correcting or reversing the damage would require taking steps such as reforestation along with stopping deforestation. With this ingrained in a carbon tax policy and automatically able to include it in a BTA, this would change behavior worldwide.

¹⁶⁹ Stephen Sewalk & Vincent Buscarello, *A New Lens for a New Perspective: The Emerging Post-Kyoto Climate Policy Framework as Explained through a New Enviro-economic Metrics*, 6 J. EUEC (2013), available at <http://www.euec.com/euecjournal.aspx> [<https://perma.cc/HA9W-D7TF>].

¹⁷⁰ Emilio Lebre La Rovere & Andre Santos Pereira, *Brazil Climate Change: A Country Profile*, SCIDEV (Feb. 14, 2007), available at <http://www.scidev.net/global/policy-brief/brazil-climate-change-a-country-profile.html> [<https://perma.cc/W6TM-C3B2>].

¹⁷¹ As an example, take a country with an economy of \$900 billion and emissions of three billion tons. This would imply an emissions intensity of one ton of GHG emissions per \$300 of GDP. At a \$50 per ton carbon tax, this is equivalent to $\$50/\$300 = 16.67\%$ tax rate. If the rate begins at \$5/ton and increases within ten years to \$50/ton, this country would have a significant incentive to rapidly reduce emissions, or face BTA that would significantly crimp its exports.

¹⁷² The tax rate begins at \$5 per ton of carbon emissions, and increases by \$5 per ton each year until at year ten the rate plateaus at \$50 per ton.

¹⁷³ Robert J. Gordon, *The Phillips Curve is Alive and Well: Inflation and the NAIRU During*

unnecessary demand inflation by giving the supply side time to build capacity.¹⁷⁴ This structure creates certainty for industry and consumers, allowing everyone to plan for the future with the understanding that the rate will increase, but so will the production of clean sources of energy.

TABLE 4: CARBON TAX RATE TABLE

Year	Tax Rate Per Ton of CO ₂
1	\$5.0
2	\$10.0
3	\$15.0
4	\$20.0
5	\$25.0
6	\$30.0
7	\$35.0
8	\$40.0
9	\$45.0
10	\$50.0
11	\$50.0
12	\$50.0
13	\$50.0
14	\$50.0
15	\$50.0
16	\$50.0
17	\$50.0
18	\$50.0
19	\$50.0
20	\$50.0

1. Domestic Production and Imports

Trade is a critical area to discuss. Many authors of both cap-and-trade and carbon tax papers believe that there is no simple and clear

the Slow Recovery, NBER, available at <http://www.nber.org/papers/w19390> [<https://perma.cc/JAF3-MQXT>].

¹⁷⁴ John Berdell, *An Early Supply-Side-Demand-Side Controversy: Petty, Law, Cantillon*, 24 J. ECON. PERSPECTIVES 207, 207–17 (2010).

legal method of implementing a BTA.¹⁷⁵ However, I disagree. We know that the purpose of a BTA is to counter what has occurred in the 1990s and 2000s, i.e., FDI escaping to developing countries with no emissions limits, causing significant “carbon leakage.” Economic competitiveness has been cause for concern in developed countries. It led the U.S. Senate to not ratify Kyoto. It has also caused concern within the EU that the EU-ETS and resulting carbon leakage is impacting corporate and country competitiveness.¹⁷⁶ Carbon leakage occurs because a trading area (EU) or developed country adopts or pretends to adopt legislation limiting GHG emissions (cap and trade), the effect is that emission dependent industries (those heavily reliant on fossil fuels that are mobile manufactures) relocate operations to countries where there are no emissions restrictions or threats of restrictions.¹⁷⁷ Companies seeking to minimize costs (and environmental regulations) of energy-intensive (high-carbon emitting) goods move production to developing countries. The problem is that these developing countries tend to be less energy efficient (releasing more emissions per dollar of GDP) and as a result these moves produce more emissions.¹⁷⁸

A good example of a BTA is a value-added tax (“VAT”), which is used in over 140 countries.¹⁷⁹ Applying a VAT is straightforward, as it only requires data that should be easily available, which is why I use the VAT structure for my carbon tax.¹⁸⁰ The data needed for the VAT regarding imports is simply the price of the good and, for exports, a confirmation that the goods were actually exported.¹⁸¹

2. Exports and Imports

For this carbon tax, when it comes to exports, as with a VAT, they are exempted; it is up to the importing country to tax the goods and

¹⁷⁵ *Id.*

¹⁷⁶ Stephanie Monjon & Phillippe Quirion, *A Border Adjustment for the EU ETS: Reconciling WTO Rules and Capacity to Tackle Carbon Leakage*, 10 ANNUAL CONFERENCE OF THE EURO-LATIN STUDY NETWORK ON INTEGRATION AND TRADE 2 (2012).

¹⁷⁷ Glen P. Peters & Edgar G. Hertwich, *Trading Kyoto*, 2 NATURE REP. 40, 40 (2008).

¹⁷⁸ *Id.*

¹⁷⁹ *International Indirect Tax. Value-added Tax Services*, KPMG, available at <https://www.kpmg.com/us/en/services/tax/indirect-taxes/vat-services/documents/vat-services.pdf> [<https://perma.cc/YRQ6-PR2A>] (last visited Mar. 20, 2016).

¹⁸⁰ For a description of how VATs and consumption taxes work, see David A. Weisbach, *Ironing Out the Flat Tax*, 52 STAN. L. REV. 599, 603–13 (2000).

¹⁸¹ CHARLES E. MCLURE, JR., THE VALUE-ADDED TAX: KEY TO DEFICIT REDUCTION? 15–20, 23–25 (1987).

services. For imports, just like the VAT, it is necessary to know the originating country (and therefore its carbon intensity) as well as the price of the goods (or services). The only difference is the need to know how much emissions were produced by the ship carrying the goods. This is important because no country claims shipping emissions—a key dilemma in the existing structure of measuring total emissions.¹⁸² By having shipping emissions added to each shipment and adding the emissions intensity, it is easy to calculate the respective carbon tax on the imported goods. Each country would have its own emissions intensity. Calculating shipping emissions is quite easy, as it is based on fuel consumed and the type of fuel. The EU has been attempting to regulate shipping emissions, and my system would account not only for emissions intensity of goods but also for shipping emissions.¹⁸³ However, each trading region or country, to avoid WTO litigation, would need to set up their carbon tax to comply with the WTO. For the United States, this means each state and territory would need to have its own carbon tax level, and for the EU, each country would need its own carbon tax level, thereby not biasing another country based on energy inputs into the production process.¹⁸⁴ Solving the border tax adjustment is key to implementing a successful carbon tax and very important in terms of successfully reducing not only U.S. or EU emissions, but also global emissions.

C. *Tax Revenue Usage (Need for Reinvestment)*

There are many uses for revenue raised by a carbon tax. However, the objective of developing and designing a carbon tax should not be to raise monies to simply return them to the public (with minimal impact on emissions except those caused by the price elasticity of demand), nor should it be to create revenues for deficit prone governments. Rather the objective should be to maximize the impact on reducing emissions. As shown in section I, all of the proposals simply reallocate money, relying on price to change behavior and hoping that technology will evolve that will magically reduce emissions.

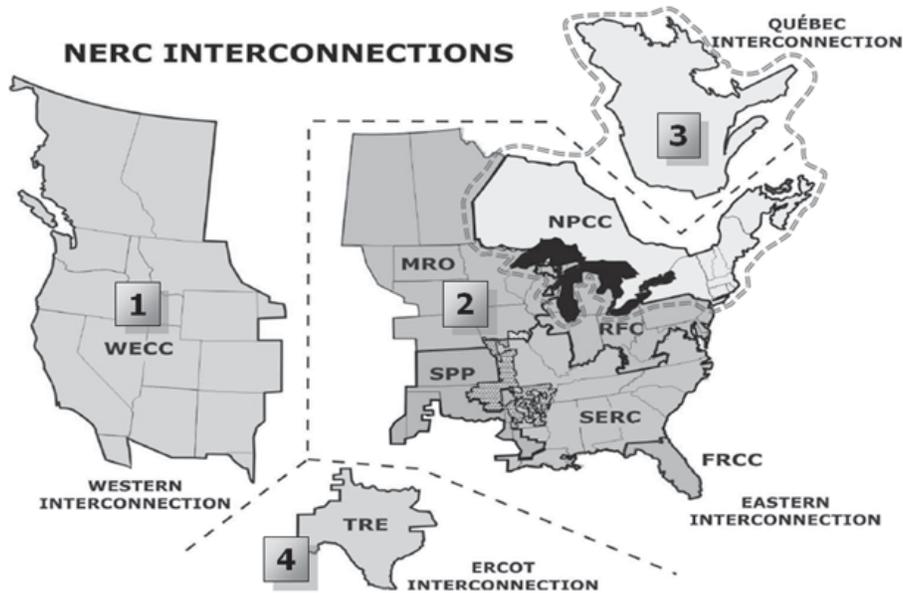
¹⁸² Jessica L. Hardcastle, *Emissions Rules Set to Increase Shipping Costs*, ENVTL. READER, Oct. 9, 2013, available at <http://www.environmentalleader.com/2013/10/09/emissions-rules-set-to-increase-shipping-costs/> [<https://perma.cc/H54B-CFXU>].

¹⁸³ *Id.*

¹⁸⁴ Stephen Sewalk, *A Carbon Tax with Reinvestment is WTO Compatible*, 25 FORDHAM ENVTL. L. REV. 17, 17 (2014).

Given that we have the technology today to create an emissions-free world, I designed this tax to invest in this technology. I do so in this scheme by taking all of the revenue raised by the carbon tax and reinvesting it into building alternative, renewable and nuclear power. This includes wind, solar,¹⁸⁵ and deep geothermal, among others, thereby encouraging the production of these energy sources by ordering and finding acceptable sites for them.¹⁸⁶ Furthermore, funding is invested into integrating the power grid between regions and countries, to share power more effectively and efficiently, see Figure 7. This helps to minimize the amount of new power plants that need to be built.

Figure 7. North American Energy Interconnections



Source: Michael Jaeger, *Washington Times*, August 1, 2012

¹⁸⁵ Solar includes not only residential photovoltaic ("PV"), but large scale PV and Thermal as well as Transpired Solar Air Collectors.

¹⁸⁶ Ronald H. Rosenberg, *Making Renewable Energy a Reality: Finding Ways to Site Wind Power Facilities*, 32 WM. & MARY ENVTL. L. & POL'Y REV. 635, 635 (2008).

In doing so, developing a greater cleaner power supply that is more reliable¹⁸⁷ and by connecting the interconnections we would allow our power systems to operate more efficiently, as peak power demand occurs at different times across the country.¹⁸⁸ Further, funds are invested in Smart Grid¹⁸⁹ to allow utilities to more efficiently use power while minimizing peak power loads.¹⁹⁰

Rather than rely on higher prices resulting in shifts in consumer demand, this tax proactively changes the power supply, reducing the supply of emissions, thereby decreasing the carbon intensity of all goods and services. Due to the tax being allocated to construct power plants, the result is significant new construction leading to job creation and a revived manufacturing base, thereby stimulating the economy, leading to a planned reduction in emissions and a declining total tax collected because of collapsing emissions. This combined impact results in a significant decline in total carbon or greenhouse gas emissions.¹⁹¹ This forms the foundation for the Carbon Tax with Reinvestment (“CTR”).¹⁹²

D. *Impact to Consumers’ Wallets (Economics)*

How do the economics of the CTR work? First, we begin with a simple figure to compare emissions intensity and cost of energy for one American, see Figure 8.

¹⁸⁷ Juan Manuel Carrasco et al., *Power-Electronic Systems for the Grid: Integration of Renewable Energy Sources: A Survey*, 53 IEEE TRANSACTIONS ON INDUSTRIAL ELECTRONICS (2006), available at <http://ecee.colorado.edu/~ecen4517/materials/refs/inverters/CarrascoGridIntegration2005.pdf> [<https://perma.cc/5U44-QGR2>].

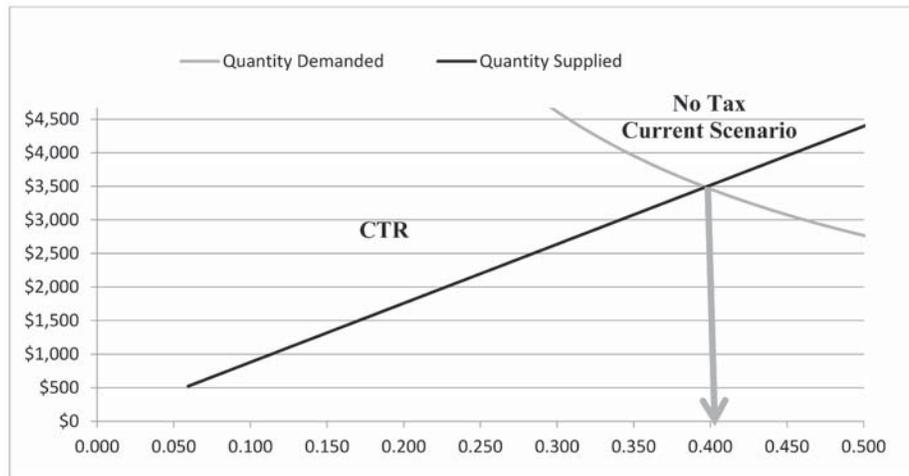
¹⁸⁸ A. Ipakchi & F. Albuyeh, *Grid of the future*, 7 POWER & ENERGY 52–62 (2009), available at <http://kzx-thesis-beta.googlecode.com/svn/trunk/%E6%96%87%E6%A1%A3/grid%20of%20the%20future.pdf> [<https://perma.cc/9GPK-MF6E>].

¹⁸⁹ *The Smart Grid: An Introduction*, U.S. DEP’T OF ENERGY, available at [http://energy.gov/sites/prod/files/oeprod/DocumentsandMedia/DOE_SG_Book_Single_Pages\(1\).pdf](http://energy.gov/sites/prod/files/oeprod/DocumentsandMedia/DOE_SG_Book_Single_Pages(1).pdf) [<https://perma.cc/X5GY-DEXY>].

¹⁹⁰ Jeff St. John, *Making the Case for Smart Grid to Shave Peak Power*, GREEN TECH MEDIA (Aug. 2, 2012), available at <http://www.greentechmedia.com/articles/read/making-the-case-for-smart-grid-to-shave-peak-power> [<https://perma.cc/Q66P-GJPA>].

¹⁹¹ Figure 9 shows the decrease in anticipated demand for goods and services with high CO₂ emissions resulting in a decline in total emissions. This is a shift in demand from Quantity Demanded to Qd*. The most significant shift however occurs on the supply side, as supply shifts from Quantity Supplied to Qs*. This is a result of changing the power sector to clean power, as shown in Figures 5 and 6.

¹⁹² Stephen Sewalk, *Carbon Tax with Reinvestment Trumps Cap-and-Trade*, 30 PACE ENVTL. L. REV. 580, 580 (2013). This article demonstrated why a CTR is much better than a cap-and-trade; however, it does not contain an explanation of the development behind the design of the tax.

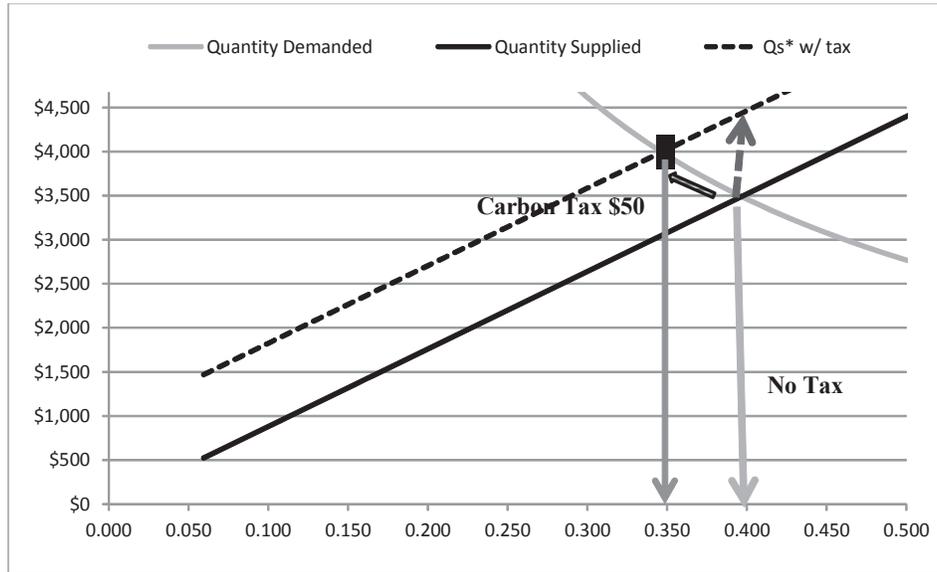
Figure 8. Cost of Carbon Energy vs. GDP per Ton of Emissions

As Figure 8 illustrates, under the current scenario (no carbon tax or cap-and-trade) the United States emits approximately 0.4 tons of carbon per \$1,000 of GDP. Putting this in a different perspective, the United States creates \$2,500 of GDP for every ton of carbon emitted.¹⁹³ The average American produces approximately 18.9 tons of carbon per year and spends \$3,460 per year on energy, which is approximately equivalent to \$183 per ton of carbon.¹⁹⁴ Therefore, this graph matches emissions per \$1,000 of GDP and the amount of money that an average American will spend on energy each year. This is important to demonstrate what would happen if a \$50 per ton carbon tax is applied. If the average American consumes 18.9 tons of carbon and a \$50 per ton carbon tax, this would increase an average American's energy bill from \$3460 to \$4404, as seen in Figure 9, assuming people had the additional monies to spend.¹⁹⁵

¹⁹³ *International Energy Statistics*, U.S. ENERGY INFO. ADMIN., <https://www.eia.gov/cfapps/ipdbproject/IEDIndex3.cfm?tid=91&pid=46&aid=31> [<https://perma.cc/Z3WX-USAB>] (last accessed Jan. 20, 2016).

¹⁹⁴ 2009 *Energy Expenditure Per Person*, U.S. DEP'T OF ENERGY, <http://energy.gov/maps/2009-energy-expenditure-person> [<https://perma.cc/DF3-QGY9>] (last visited Mar. 20, 2016).

¹⁹⁵ Using \$50 per ton and multiplying by 18.9 tons of carbon would result in an additional cost of \$945. If we add $\$3460 + \$945 = \$4405$.

Figure 9. Impact of \$50 Carbon Tax

However, the actual bill never increases to \$4,404, because the average person could not afford this, leading to a more energy efficient economy as people use energy more efficiently.¹⁹⁶ The intersection between the Quantity-Demanded curve and the Quantity-Supplied curve is \$3,460 in energy spent per person and 0.4 tons of carbon emissions per \$1,000 of U.S. GDP.¹⁹⁷ Imposing the carbon tax of \$50 per ton shifts the supply curve. The total cost of energy would now be equivalent to $\$183 + \$50 = \$233$. $\$233 \times 18.9$ (tons of carbon consumed) = \$4,404 per person. As a result, emissions decline due to reduced demand, as all goods (and services) become more expensive. This results in the intersection between Quantity-Demanded and Q_s^* (with a carbon tax of \$50). The economy becomes more energy efficient as energy use declines, but this comes at a high cost to households as noted by the previously mentioned studies.

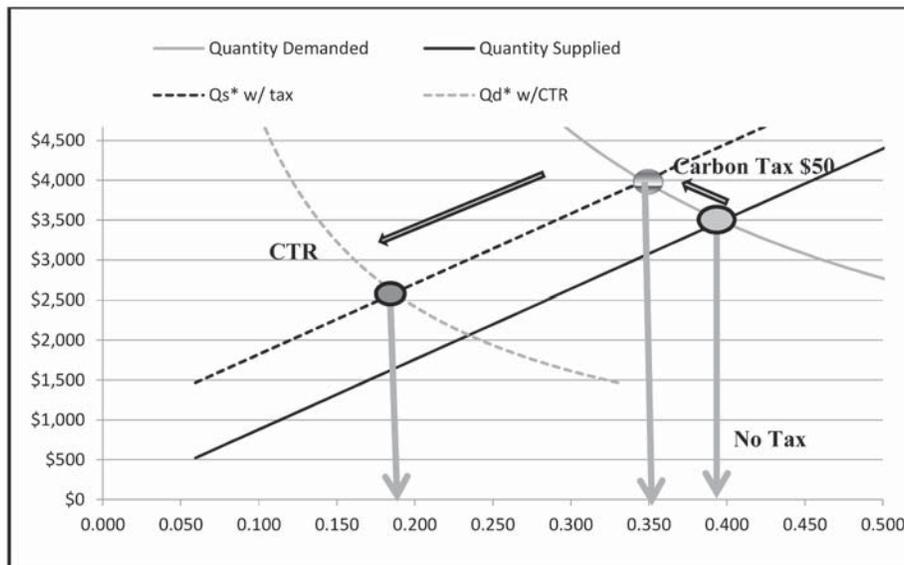
How would a Carbon Tax with Reinvestment (“CTR”) affect industry and households and could a properly designed Carbon Tax actually incentivize growth, maintain standards of living, and significantly reduce

¹⁹⁶ This could include planning trips, less driving, using public transport, turning the temperature down in the house, turning off lights more frequently, using CFL and LED lights, as well as purchasing more fuel efficient autos and appliances and making a home (or building) more energy efficient.

¹⁹⁷ See, e.g., Espey, *supra* note 126.

emissions? The revenues raised are used to build new power plants, creating significant levels of new jobs and economic output. The result is a new power infrastructure that is clean in comparison to the existing structure. As households pay for the power plants the cost of future power (electricity) declines, as Utilities did not pay for the infrastructure. As a result, the Public Utility Commissions no longer needs to reward utilities with returns on assets paid for by the populace. The shift in quantity is tremendous and clearly outpaces the impact of purely rising costs from the carbon tax, as shown in Figure 10. As a governmental goal, reducing energy costs for people and for families is very important to maintain standards of living and happiness.¹⁹⁸ The CTR promotes not only improved energy efficiency, but also cleaner energy, thereby essentially eliminating the need to subsidize clean energy by actually purchasing it.

Figure 10. Impact of a Carbon Tax with Reinvestment



As seen in Figure 10, Q_s^* (\$50 carbon tax) now intersects with Q_d^* (“CTR”). The results are clearly impressive. Although household costs increased due to the tax, the rebate in the form of cheaper, cleaner energy results in a net savings to households and industry, bringing down per

¹⁹⁸ Mark Calabria, *Reducing Energy Costs Offers Potential to Reduce Financial Burdens for All Families*, BIPARTISAN POL'Y CTR., available at <http://bipartisanpolicy.org/reducing-energy-costs-offers-potential-reduce-financial-burdens-all-families/> [<https://perma.cc/MG6E-JUJL>] (last visited Mar. 20, 2016).

capita costs of energy to approximately \$2,500 per year within twenty years. The neutrality of the CTR is preserved by refunding the tax collected through cheaper, cleaner power in the relatively near future. As the CTR also creates the structure for a BTA this means that a country's international competitiveness increases as energy costs drop due to clean energy. The new equilibrium shows energy efficiency improved by more than 52% (reduction in emissions) as well as reduced energy costs, all within twenty years. Consumers (emitters) paying for the power infrastructure would introduce an era of cheap, clean power that would electrify the economy. More importantly, this result shows it is possible to create a carbon tax using reinvestment that actually stimulates growth, maintains or increases standards of living, while significantly reducing emissions—all feats that no one has so far been able to accomplish.

The WTO¹⁹⁹ compliant tax results in no incentive to invest in production in noncompliant regions and therefore no carbon leakage²⁰⁰—resulting in an incentive for other countries to adopt this tax structure and leading to a worldwide abatement effort for GHG emissions.²⁰¹ A universal, easy-to-calculate tax on carbon quantities would eliminate equity and discrimination concerns and avoid breaching WTO laws regarding import taxes “in excess of those applied, directly or indirectly, to like domestic products,”²⁰² as the rates would be applied uniformly to like regions.

Note that a flat carbon tax imposed uniformly on total emissions without calculating emissions intensity may be subject to the most favored nation principle.²⁰³ Although the tax is a single rate for all countries, each country emits different types of GHG. GHG emissions in 2010 came predominantly from three sources, all fossil fuels.²⁰⁴ Additionally, different countries use different sources to produce energy, resulting in different

¹⁹⁹ Eric Phillips, *World Trade and the Environment: The Café Case*, 17 MICH. J. INT'L L. 827, 842 (1996); see generally Sewalk, *supra* note 184.

²⁰⁰ Carbon leakage occurs when industry moves to countries with no effective carbon limits (tax or cap-and-trade). These goods are then imported into regions with these regulations, thereby increasing total emissions. A carbon tax with reinvestment results in an effective Border Tax Adjustment (“BTA”). As there is no advantage to move, i.e., all goods and services are taxed, industry does not move solely because of the imposition of this carbon tax scheme.

²⁰¹ Sewalk, *supra* note 184, at 377.

²⁰² General Agreement on Tariffs and Trade, art. III, Oct. 30, 1947, 61 Stat. A-11, 55 U.N.T.S. 194 [hereinafter *GATT*].

²⁰³ *Id.* at art. I.

²⁰⁴ 46% of emissions were from coal, 33% were from fuel, and 20% were from gas. *Recent trends in world CO2 emissions from fuel combustion*, INT'L ENERGY AGENCY, available at https://www.iea.org/media/news/2015/news/151104_webarticle_CO2_FINAL.pdf [<https://perma.cc/YU7J-MFVH>] (last visited Mar. 20, 2016).

emission intensities. China produces 70% of its power from coal,²⁰⁵ while France gets a majority of its power (75%) from nuclear energy.²⁰⁶

Consequently, countries will be able to argue that the energy inputs from different sources are not like inputs and therefore imposing a uniform tax rate on every type of emissions is favoring certain nations over others since the emissions come from different makeups.²⁰⁷ Treating all different types of energy resources equally will result in discrimination and a violation of Article I of GATT.²⁰⁸ This is because the tax is calculated by looking at the amount of GDP per ton of emissions, resulting in an emissions intensity of GDP per ton of CO₂ equivalent, essentially an input.²⁰⁹

III. REDUCING EMISSIONS BY APPLYING THE TAX

A. *The Tax Applied*

The existing carbon tax proposals, as well as the current cap-and-trade proposals, cannot guarantee with any level of certainty the reduction of U.S., EU, or global carbon emissions. For legislation to be effective, it is necessary that it be proactive. Proactive legislation would incorporate all emitters and provide assurance that emissions will be reduced by addressing supply and demand.

A more efficient, effective and simpler approach to shrinking emissions would utilize a market-based approach and model the carbon tax as a CTR. As proposed this CTR structure taxes all carbon consumers using a downstream approach, as compared to the upstream limited approach of the cap-and-trade proposals. The tax structure therein incorporates all societal costs of GHG emissions, thereby promoting accountability and a reduction in emissions. However, unlike the cap-and-trade where revenues would go to general government funding, the CTR uses the funding to reinvest in clean power infrastructure. This payoff provides producers and consumers with a clear message of the harm caused by carbon emissions and the reinvestment resulting in the construction of clean energy facilities and elimination of polluting facilities clearly emphasizes this message.

²⁰⁵ *China produces and consumes almost as much coal as the rest of the world*, U.S. ENERGY INFO. ADMIN. (May 14, 2014), <http://www.eia.gov/todayinenergy/detail.cfm?id=16271> [<https://perma.cc/3WGX-63X2>] (last visited Mar. 20, 2016).

²⁰⁶ *Nuclear Power in France*, WORLD NUCLEAR ASSOC., <http://www.world-nuclear.org/info/inf40.html> [<https://perma.cc/LUL4-JCS4>] (last visited Mar. 20, 2016).

²⁰⁷ Phillips, *supra* note 199.

²⁰⁸ Sewalk, *supra* note 184, at 388.

²⁰⁹ *Id.*

B. Role of Emissions Intensity

To avoid discriminating by source, this is solved by the United States adopting a fifty U.S. State + Territory + D.C. individual CTR rates. The EU-27 would adopt a minimum of twenty-seven CTR rates, meaning each U.S. State will have its own carbon (value added) tax structure. In this manner U.S. states replicate the majority of the world's countries in terms of emissions intensity as seen in Table 5, the same with the EU-27.

TABLE 5: EMISSIONS INTENSITY, COMPARING U.S. STATES VS. SELECT COUNTRIES

\$ of GDP per Ton of CO₂ Emissions			
Alabama	\$892.86	India	\$448.43
California	\$3,703.70	Japan	\$3,448.28
		France	\$4,000.00
Washington	\$2,941.18	United Kingdom	\$3,571.43
Colorado	\$1,886.79	Euro Area	\$2,500.00
		United States	\$2,040.82
Texas	\$1,250.00	Australia	\$1,298.70
Wyoming	\$305.81	China	\$312.50

Source: Table 5 Emissions intensities using 2005 comprehensive data set. Current Dollar GDP and Emissions data for U.S. states provided by the U.S. Energy Information Association²¹⁰ and the World Resources Institute's Climate Analysis Indicator Tool ("CAIT"),²¹¹ respectively. GDP for countries from World Bank.²¹²

This is done so that a BTA can be applied to imported goods (and services) and so that it is easy to calculate as the information is easily available.

²¹⁰ *State energy-related carbon dioxide emissions by year*, U.S. ENERGY INFO. ASSOC., <http://www.eia.gov/environment/emissions/state/analysis/pdf/table1.pdf> [https://perma.cc/LA39-9ZEB] (last visited Mar. 20, 2016).

²¹¹ Greg Fuhs, *A New, One-Stop Shop for Greenhouse Gas Emissions Data*, WORLD RESOURCES INST. (July 10, 2013), <http://www.wri.org/blog/2013/07/new-one-stop-shop-greenhouse-gas-emissions-data> [https://perma.cc/LXV2-WZ53] (last visited Mar. 20, 2016).

²¹² World Development Report, *supra* note 34. Stephen Sewalk & Vincent Buscarello, *A new lens for a new perspective: The emerging post-Kyoto climate policy framework as explained through new enviro-econometrics*, 6 J. EUEC 13, 13 (2013).

C. *A Simple, Functioning Tax + Transportation Policy*

“Keep it simple” is a good motto, and a carbon tax with reinvestment is fundamentally simple. My proposal calls for the tax to start at \$5 per ton of carbon contained within a good or service based on emissions intensity.²¹³ To simply further, the tax is calculated based on the price of a good and paid at the register, much like a sales or value added tax. Using emissions intensity implies everyone is responsible for emitting carbon or GHG, therefore no one is exempt from the tax. The tax starts at a low level and increases by \$5 per ton of carbon per year.²¹⁴ This ramp up provides: (1) price certainty to industry and consumers; (2) certainty for investment; (3) time for the construction industry to ramp up their capacity in production as well as their work force, while avoiding demand-led inflation; and (4) to simplify the adoption of this tax as a border tax adjustment (“BTA”).

If utilities and industry, as well as buildings, only had access to clean power this would significantly reduce global emissions, hence why I developed the concept of reinvestment with a carbon tax, leading to the construction of new, clean, emissions free power to replace current power generation. A building with clean power produces no emissions, the same with industry.²¹⁵ A carbon tax with reinvestment essentially solves emissions from utilities and buildings, effectively driving emissions in these sectors to zero within thirty years. By cleaning up these sectors, it is then possible to examine transportation, which I briefly mention here and present, but leave the details for a future paper. Transportation today is heavily dependent on gasoline and diesel.²¹⁶ A CTR could subsidize the

²¹³ Emissions intensity is the amount of emissions contained in a dollar of GDP. Put another way, it is easy to calculate, take GDP and divide by total emissions. For the United States this would be \$15 trillion / 6 billion tons of carbon or GHG emissions resulting in the fact that for everyone \$2,500 of GDP, one ton of carbon or GHG emissions is produced. To reduce global emissions we need to produce more GDP per ton of emissions or in the converse, we need fewer emissions per dollar of goods and services produced.

²¹⁴ See *infra* Figures 1 and 2, for the revenues calculated from the carbon tax, beginning at \$5/ton in year one and increasing by \$5/ton each year until the tax reaches \$50/ton in year ten. The revenues are calculated as a percent of the U.S. and the EU-27 GDPs.

²¹⁵ *Clean Energy*, UNION OF CONCERNED SCIENTISTS, http://www.ucsusa.org/clean_energy [<https://perma.cc/4V2E-ZB43>] (last visited Mar. 20, 2016).

²¹⁶ *How We Use Energy, Transportation*, THE NAT'L ACADEMIES, <http://needtoknow.nas.edu/energy/energy-use/transportation/> [<https://perma.cc/2URR-QWRR>] (last visited Mar. 20, 2016).

introduction of automobiles powered by electricity (battery) as well as hydrogen fuel cells. The United States currently has enough generating capacity to power an entire fleet of plug-in vehicles.²¹⁷ By replacing the current power generation capacity of utilities, we could then cleanly power 225 million plug-in cars by 2050.²¹⁸ This is very important to reducing emissions from transport, given that personal vehicle use accounts for over 60%, while the remainder comes from buses, trucks, rail, ships and aircraft.²¹⁹

Let us employ a simple application of this concept. Currently Brazil,²²⁰ a major hydroelectric producer, and Australia,²²¹ a natural gas producer, export significant amounts of iron ore to China. Exports total approximately 800 million tons of iron ore.²²² This rock ore burns more fuel to transport because it is heavier than steel; it is shipped by rail using diesel fuel to port; it is loaded on a ship that burns bunker fuel, which is bottom-of-the-barrel, heavily polluting fuel; and when it arrives in China, it is shipped by rail again to a steel smelter that uses coal to produce steel.²²³ Under a CTR, this would be prohibitive and Chinese steel would no longer be competitive in world markets.²²⁴ Instead, a CTR would refocus Brazil to create jobs locally to mine the ore with clean production methods and smelt the ore into steel using hydroelectric power. The steel is shipped to China and other destinations on (hydro) electric-powered trains to ships using batteries, fuel cells, or nuclear power. The same results processed

²¹⁷ MICHAEL J. SCOTT ET AL., IMPACTS ASSESSMENT OF PLUG-IN HYBRID VEHICLES ON ELECTRIC UTILITIES AND REGIONAL U.S. POWER GRIDS, PACIFIC NORTHWEST NATIONAL LABORATORY (Nov. 2007), available at http://www.roguevalleycleancities.org/images/news.html/PNNL%20Articles/PHEV_Economic_Analysis_Part2_Final.pdf [<https://perma.cc/AW6C-CVG2>].

²¹⁸ *Id.*

²¹⁹ *Transportation's Role in Reducing U.S. Greenhouse Gas Emissions, Volume 1: Synthesis Report*, U.S. DEP'T OF TRANSPORTATION, (2010) (report to Congress), available at http://ntl.bts.gov/lib/32000/32700/32779/DOT_Climate_Change_Report_-_April_2010_-_Volume_1_and_2.pdf [<https://perma.cc/66U7-RXU7>]; *Reducing emissions from transport*, EUR. COMM. ON CLIMATE ACTION, available at http://ec.europa.eu/clima/policies/transport/index_en.htm [<https://perma.cc/8V7Z-URYC>].

²²⁰ Clyde Russell, *Australia, Brazil boost China iron ore import share, but not enough*, REUTERS (Jan. 27, 2016), <http://www.reuters.com/article/us-column-russell-ironore-china-idUSKCN0V5147> [<https://perma.cc/9J22-4LP3>].

²²¹ *Id.*

²²² *Id.*

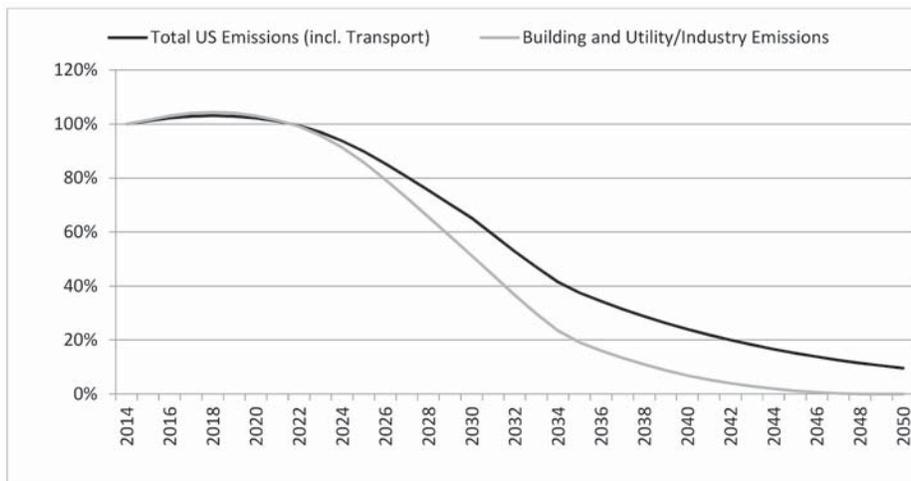
²²³ *Fact Sheet: Steel and raw materials*, WORLDSTEEL ASS'N, https://www.worldsteel.org/publications/fact-sheets/content/00/text_files/file0/document/fact_raw%20materials_2014.pdf [<https://perma.cc/9SZQ-WAQ3>] (last updated Oct. 2014).

²²⁴ David L. Chandler, *One order of steel; hold the greenhouse gases*, MIT NEWS (May 8, 2013), <http://news.mit.edu/2013-steel-without-greenhouse-gas-emissions-0508> [<https://perma.cc/4CNV-R3LT>].

in a different manner reduce emissions from approximately 1.6 billion tons of CO₂ to less than 500 million tons, or 67% fewer emissions.²²⁵

What would happen, therefore, if we adopted a carbon tax with reinvestment with a simple rule that starting in 2030 all gas and diesel powered vehicles need to be replaced with electric batteries or fuel cells by 2060? To achieve this, a policy to replace all vehicles over thirty years could be adopted, meaning a minimum of 7.5 million vehicles per year need to be fuel cell or battery powered. The policy would need to include a transition from gasoline and diesel to these new fuel sources, resulting in no more sales of fossil fuels after 2060. I modeled this in Figure 11 through 2050. Through 2060, emissions drop 95% and by 2017 I believe it is possible for to drop approximately 98% based on my models.

Figure 11. A CTR with an Electric/Fuel-Cell Vehicle Policy



Building and Utility/Industry emissions reach zero in 2048. By 2050, total U.S. emissions have declined by 90% compared to 2012 emission levels.²²⁶

²²⁵ See *Saving One Barrell of Oil per Ton (SOBOT): A New Roadmap for Transformation of Steelmaking Process*, AM. IRON & STEEL INST. (Oct. 2005), https://www.steel.org/~media/Files/AISI/Public%20Policy/saving_one_barrel_oil_per_ton.pdf [<https://perma.cc/SKA2-VNLH>] (Author estimates in combination with the SOBOT Report resulted in the estimate of 1.6 billion tons of CO₂ to less than 500 million tons (or 67% fewer emissions)).

²²⁶ *Table 1-11: Number of U.S. Aircraft, Vehicles, Vessels, and Other Conveyances*, DOT,

CONCLUSION

The world needs a climate change policy that effectively and efficiently reduces greenhouse gas emissions. A carbon tax system with reinvestment results in a combined reduction in demand due to higher prices as well as reducing the supply by changing our power grid. This policy is proactive and produces results, but it needs to be supplemented with a transport directive to replace all fossil fuel powered vehicles with fuel cell and battery/electric vehicles. Doing so, we can reduce U.S. emissions by upwards of 90% by 2050 and 95% by 2060, and 98% by 2070. The BTA of a CTR would readily encourage other nations to adopt a CTR and transport policy directive to avoid being locked out of the world's largest consumer market (the United States) by having a CTR applied as a BTA on their exports of goods and services. As with the VAT, I would anticipate this policy would be rapidly adopted across countries once implemented by one major country, which I hope to show in another paper using Game Theory.

